DOCUMENT RESUME

ED 230 376 SE 041 573

AUTHOR	Iozzi, Louis A.; And Others
TITLE	Future Scenarios in Communications. [Student's Guide.] Preparing for Tomorrow's World.
INSTITUTION	Rutgers, The State Univ., New Brunswick, N.J. Center for Coastal and Environmental Studies.
SPONS AGENCY	New Jersey State Dept. of Education, Trenton.
PUB DATE	80
NOTE	74p.; For related documents, see SE 041 564-585. A complete catalog of the multi-media packages making up this program is contained in SE 041 585.
AVAILABLE FROM	SOPRIS WEST, Inc., 1120 Delaware Ave., Longmont, CO 80501 (Complete multi-media module, including student materials, $85; replacement student worksheets, $9).
PUB TYPE	Guides - Classroom Use - Materials (For Learner) (051)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Communications; *Computers; Critical Thinking; Decision Making; Delphi Technique; Environmental Education; *Futures (of Society); Interdisciplinary Approach; Junior High Schools; Learning Activities; Moral Development; *Moral Issues; *Prediction; Problem Solving; Science Education; Secondary School Science; Social Studies; Technology; *Telephone Communications Systems; Trend Analysis
IDENTIFIERS	Preparing for Tomorrows World Program; Scenario Writing; *Science and Society

ABSTRACT

The purpose of this module is to introduce students (grades 7-8) to the concept of change and factors influencing change. The module is composed of two major sections. Section 1 examines the development of the telephone system in the United States and introduces four futures forecasting techniques (Delphi probe, cross-impact matrix, trend analysis, and scenario development). In section 2, students use the forecasting techniques they have learned to examine the development and applications of the computer. In addition to futures forecasting techniques, readings, role-playing simulations, and small/large group discussions are employed. The module may be used as a separate unit of study, as a mini-course, or incorporated into social studies, history, general science, or language arts courses. (JN)

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PREPARING FOR TOMORROW'S WORLD

Future Scenarios in Communications

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Preparing for Tomorrow's World
An Interdisciplinary Curriculum Program

Coastal Decisions: Difficult Choices
Energy: Decisions for Today and Tomorrow
Future Scenarios in Communications
Space Encounters
Technology and Changing Life-Styles
Food: A Necessary Resource
Perspectives on Transportation
Future New Jersey: Public Issues and the Quality of Life
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The materials presented herein were prepared pursuant to a grant from the New Jersey State Department of Education under provisions of Title IV-C of the Elementary and Secondary Education Act (1965), as amended. However, the opinions expressed herein do not necessarily reflect the position or policy of the New Jersey Department of Education or the U.S. Office of Education.

PREPARING FOR TOMORROW'S WORLD

Future Scenarios in Communications

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ACKNOWLEDGEMENTS

A project of this broad scope reflects the contributions of many individuals who have shared with us their professional expertise, creative insights, wisdom and support. Our deepest appreciation and special thanks are extended to:

Highland Park Public Schools
- Board of Education
- Dr. James Sgambettera, Superintendent
- Dr. Edward Leppert, Assistant Superintendent
- Mr. William Donohue, Assistant Principal, Highland Park High School

Center for Coastal and Environmental Studies, Rutgers University
- Dr. Norbert P. Psuty, Director
- Dr. Leland G. Merrill, Professor
- Dr. Karl Nordstrom, Assistant Professor
- Dr. Carol Litchfield, Associate Professor (presently E. I. DuPont de Nemours & Co.)
- Ms. Janice Limb, Director, Cartography Lab

Cook College - Rutgers University
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Department of Radiation Science, Rutgers University
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Graduate School of Education - Rutgers University
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New Jersey Department of Education
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New Jersey Department of Energy
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- Stanley Cesaro, President
- Peter Bastardo, Curriculum Specialist Elizabeth Public Schools Elizabeth, N.J.

Sincere appreciation is expressed to the school systems that assisted the pr[illegible] and served as field test centers. We especially thank the following teachers and their students who field tested the preliminary drafts of this program, and also those teachers and students who served as control classes. Their enthusiasm, cooperation and thoughtful critiques are integral components in the successful development of these materials.

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Dumont District
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East Brunswick Township District
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NON—PUBLIC SCHOOLS

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Br. Kevin Cunniff, Barbara Goodman, James Duris

• *St. Thomas Aquinas High School, Edison*
Betsy Piesen

PREFACE

We live in an exciting, rapidly changing, and challenging world—a world highly dependent upon science and technology. Our world is changing so rapidly that we sometimes fail to recognize that much of what we today take for granted as common, everyday occurrences existed only in the imaginations of people just a few short years ago. Advances in science and technology have brought many dreams to fruition. Long before today's school children become senior citizens, much of today's "science fiction" will, in fact, become reality. Recall just a few accomplishments which not long ago were viewed as idle dreams:

- *New biomedical advances have made it possible to replace defective hearts, kidneys and other organs.*
- *The first air flight at Kitty Hawk lasted only a few seconds. Now, a little over half a century later space ships travel thousands of miles an hour to explore distant planets.*
- *Nuclear technology—of interest a few short years ago because of its destructive potential—could provide humankind with almost limitless supplies of energy for peace-time needs.*
- *Computer technology has made it possible to solve in seconds problems which only a decade ago would require many human lifetimes.*
- *Science and technology have brought us to the brink of controlling weather, earthquakes and other natural phenomena.*

Moreover, the changes which we have been experiencing and to which we have become accustomed are occurring at an increasingly rapid rate. Changes, most futurists forecast, will continue and, in fact, even accelerate as we move into the 21st Century and beyond. But, as Barry Commoner has stated, "There is no such thing as a free lunch." These great advances will not be achieved without a high price. We are now beginning to experience the adverse effects of our great achievements:

- *The world's natural resources are being rapidly depleted.*
- *Our planet's water and air are no longer pure and clean.*
- *Thousands of plant and animal species are threatened with extinction.*
- *Nearly half the world's population suffers from malnutrition.*

While science and technology have given us tremendous power, we are also confronted with an awesome responsibility: to use the power and ability wisely, to make equitable decision tradeoffs, and to make valid and just choices when there is no absolute "right" alternative. Whether we have used our new powers wisely is highly questionable.

Today's youth will soon become society's decision-makers. Will they be capable of improving upon the decision-making of the past? Will they possess the skills and abilities to make effective, equitable, long-range decisions to create a better world?

To the student:

This module has been prepared to help you—the student and future decision maker—function more effectively in a rapidly changing world. Other modules in the *Preparing for Tomorrow's World* program focus on additional issues of current and future importance.

To the teacher:

It is our belief that this module—and indeed the entire *Preparing for Tomorrow's World* program—will help you the teacher prepare the future decision-maker to deal effectively with issues and challenges at the interfaces of science/technology/society. It is our belief that the contents and activities in this program will begin to prepare today's youth to live life to the fullest, in balance with Earth's resources and environmental limits, and to meet the challenges of tomorrow's world.

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Part I.
The Telephone

INTRODUCTION

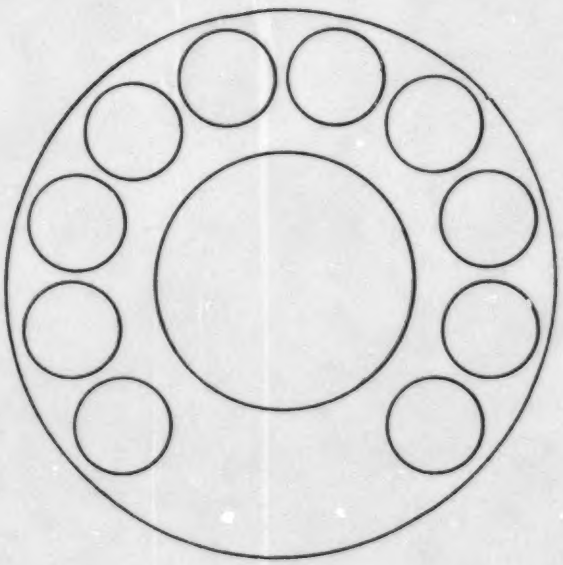
The telephone is such a commonplace object in our lives that we seldom give it much thought. You, no doubt, recognize its importance. However, have you ever thought about how much our way of life has changed after 1876, when Alexander Graham Bell invented the telephone?

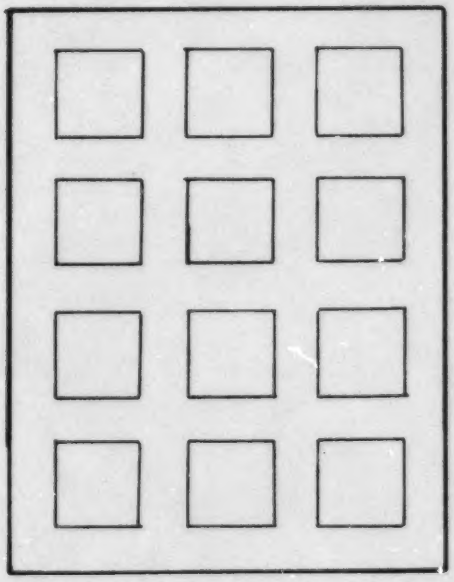
Do you think that you take the telephone for granted? Try the exercise below:

— Copy the diagram of the telephone dial *or* touch tone buttons on *another sheet of paper*

— Fill in the *numbers* and *letters in their proper places*.

DO NOT WRITE IN THIS BOOKLET.





— Did you make any mistakes?

— Was this task difficult? If so, why do you suppose the task was difficult?

Activity 1: Living Without A Telephone

To be without the telephone in today's world is unthinkable! You might try to imagine what life was like before telephones were invented by not using a telephone for a few days. This can give you an idea about how much we depend on the telephone. If suddenly we had no telephone, do you think our lives would come to a standstill?

It was only within the past 60 years that the telephone came into widespread use in the United States. Life before then was, naturally, quite different. To gain a feeling of life in the pre-telephone days, complete the following charts. Copies of the chart will be distributed. Your teacher will instruct you to work by yourself or in small groups.

Instructions for Chart Completion:

Pre-Telephone Communications Charts – Urban Community, Rural Community

On each of the charts (Rural and Urban Community) typical members of each community are listed across the top of the columns. For each person are listed two activities that might be required of him or her in the course of the day. They are living in the late 1800s. They have no access to an automobile or telephone. Climb aboard the time machine, put yourself back in time, and try to think of life a hundred years ago.

- Suggest a way for accomplishing each of the activities listed. Enter your suggestion in the space labelled "1".
- For each activity, estimate how much time it would take to accomplish the task. Enter this under "2".
  Were there any tasks that could not be accomplished?
- Under "3" estimate the furthest distance the person might travel in order to talk to another person in a different town. How would he/she get there? How often might this person talk to a friend or relative in a distant location?
- Under "4" list some of the types of information the person might obtain through the use of the telephone if he/she had one. Or, list some of the ways a telephone will help his/her work.

URBAN COMMUNITY

Owner of a Vegetable Warehouse Learn that potato shipment has been delayed by storm	**Research Scientist** Discuss a possible new discovery with scientists 100 miles away	**Fire Chief of City** Call for more equipment to a fire spreading throughout the block	**Housewife** Contact repair man to fix the leaking roof	**Worker in a Factory** Report that he/she will not be in to work
1.				
2.				
Find another source of potatoes until shipment arrives	Inform mayor that the city water supply contains dangerous germs.	Call meeting of all company captains	Tell children at home that she will be late in returning home	Invite friends to a party
1.				
2.				
3.				
4.				

DO NOT WRITE IN YOUR BOOK

RURAL COMMUNITY

Farmer (wheat farm in midwest. Nearest neighbor 3 miles)	**Newspaper Editor** local paper that publishes weekly; circulation 2,000; has staff of 3 others	**Butcher and Owner of meat market** (Sell & delivers to local customers	**Sheriff** (4-man force in rural town)	**Eighth-grade student** (Walks to school 2 miles away; 5-room school)	**Recent Immigrant** (apprentice in a tailor shop. Works from 7 AM to 7 PM. Lives in upstairs loft of shop. Cannot read or write English)
Order supplies for spring planting	Receive news of the presidential election	Get doctor for worker who has had an accident in shop	Inform the nearby towns of an escaped prisoner	Gets sick at school and wants to tell mother.	Contact relative in city 100 miles away
1.					
2.					
Sell the wheat harvest	Sending back story from the state capitol	Stop an order placed last month to stockyard because of an over-supply of meat	Round up a search team for a lost child	Arrange for trip to state capitol (needs hotel room, train ticket, tour guide)	Arrange for brother in native country to come over to work in shop
3.					
4.					
5.					
6.					

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Reading 1: Early Uses Of The Telephone

Since the earliest times, people have been seeking ways to communicate to more distant places. Examples of methods and devices used include drums, horns, signal flags, smoke signals and even long-distance runners. In the early 1800's, a major breakthrough — the telegraph — made it possible for people to send coded mesages across continents. The idea of sending the human voice over wires must have intrigued many people. In the mid-1800's, for example, the string phone was a popular plaything. Many of you have probably made similar toys as children. It consists of connecting two tubes with string or wire, and talking through one tube while another person listens with the other tube at the end of the line.

Seeking ways to communicate

Today, we think of the telephone as a necessity. It is hard for us to imagine why everyone did not rush for a telephone soon after Alexander Graham Bell invented the telephone and spoke the historic words on March 10, 1876: "Mr. Watson, come here, I want you." The early response to his invention, however, could be described as skeptical curiosity. This was also the case, four years before, when Philip Reis demonstrated what he called a "harmonic telegraph." Although his "telephone" reproduced musical tones and the human voice, people considered it only a clever toy. Even the scientists at that time did not foresee its far-reaching uses.

During the first years, much effort was made to convince people that sound could indeed be transmitted by wires. In an early public demonstration of the telephone, music was played in a distant room to the audience in an auditorium. In July 1876, Bell transmitted from Boston to New York the song "Yankee Doodle" to the telegraph operator at the other end. In all cases the transmission was one-way.

People, thus, saw the telephone as a device for providing entertainment, such as music, drama and news. Important men could deliver speeches in one place and be heard by people gathered in a distant assembly hall. The August 1876 issue of *Nature* suggested that with music provided by telephone one could give a dancing party without hiring musicians. In other words, the telephone was used as we presently use the radio. The radio (unless it is a CB radio) cannot be used to send messages. It "talks" to us instead. Today's radio also differs from the early one-way telephone in other ways. How do you think it differs?

The idea of the telephone providing entertainment soon changed when Bell developed two-way telephone transmission. With two-way transmission, a person using the same instrument would alternately talk and listen. The first order for telephones came in May 1877 from E.J. Holmes who owned a burglar alarm business. Since his customers were already connected to his office by wire, attaching telephones to the wire would allow them to call the office to request messenger or package delivery service. Telephones at that time were "private" lines that connected two places, the office to one's home or one office to another. Calls could be made only between those two points. The system of a central exchange was first used by George Coy in Hartford, Connecticut in January 1878, with 21 customers. The exchange with a central switchboard made it possible for customers to make calls to one another and not only to persons at one place.

The value of the telephone for emergencies was demonstrated during a railway accident at Tariffville, Connecticut in January 1878. News of the accident was received through telegraph by Isaac Smith, a druggist. The telephone system in his store was connected to 21 local doctors and the livery stable. He made calls that night, and the doctors and medical supplies were quickly rushed to the scene of the accident.

Despite the publicity of the telephone's role in the railroad accident, most people did not really see a need for telephone communications. Bell's early advertisement had to assure the readers that learning to use the telephone was not difficult. "Conversation can be easily carried on after slight practice and with occasional repetition of a word or sentence." His flyer also listed the advantages of installing a telephone:

> *"The advantages of the telephone over the telegraph for local business are:*
>
> *1st. That no skilled operator is required, but direct communication may be had by speech without the intervention of a third person.*
>
> *2nd. That the communication is much more rapid, the average number of words transmitted by the Morse sounder being from fifteen to twenty, by telephone from one to two hundred.*
>
> *3rd. That no expense is required, either for its operation, maintenance or repair. It needs no battery and has no complicated machinery. It is unsurpassed for economy and simplicity.*

The terms for leasing two telephones for social purposes, connecting a dwelling house with any other building, will be $20 a year; for business purposes $40 a year, payable semi-annually in advance, with the cost of expressage from Boston, New York, Cincinnati, Chicago, St. Louis or San Francisco. The instruments will be kept in good working order by the lessors, free of expense, except for injuries resulting from great carelessness."

Not all people understood how the telephone could transmit voices. Some were quite nervous and suspicious of the "talking box." Angus Hibbard, a telephone manager, wrote: "The difficulties were not only technical but at times psychological. I often was obliged to convince speakers of a foreign tongue that the telephone really would speak their language!"

Bell journeyed to Europe to interest businessmen in investing in the telephone venture. One businessman told him that there were plenty of messenger boys to run errands so there was no need for telephones.

Nonetheless, during the first ten years, many telephone exchanges were established within a local area, and people began to find uses for the telephone that they had not before considered. One of the earliest and important uses of the telephone was in the coal mines. With the telephone, the mine inspector could monitor the machines which kept air flowing through the deep shafts. Also, messages could be sent between the workers at the surface and bottom of the mine.

Businessmen found that they could more easily keep in touch with their suppliers and customers. Now they did not have to locate their stores only in the neighborhood where they did business — such as the hatter's neighborhood, the furrier's neighborhood, the fish market, the egg market, etc. When these specialized business districts became crowded, their rents were increased. With telephone service they could move into cheaper quarters and still maintain contact. The elevator and telephone also contributed to businesses moving up into high-rise buildings. Being without telephones in those tall buildings would have resulted in the scene of hundreds of messenger boys scrambling up and down elevators all day long.

The early telephone subscribers were businessmen and a few of the wealthy households. For most people, the telephone was still a luxury. In 1894, a telephone in New York City cost $240 for a business and $180 for a residence. Two-party lines were slightly less. But for the average factory worker who earned $360 yearly and a school teacher who earned $250 a year, a telephone was a far-off dream.

Soon other ideas for using the telephone were adopted and more were suggested. Those applications included railway operations, newspaper reporting, calling or sending orders to household servants, and military and naval operations. One writer suggested that in lighthouses and lightships, telephones could have an important role in bringing aid to ships in distress and preventing shipwrecks. Then there were some "far out" ideas. Bell thought that perhaps the telephone could be adapted into a device to be placed over one's head so that thoughts could be transfered without the trouble of speech! He also envisioned the day when everyone in the country would have a telephone and sing in unison over the telephone "The Star Spangled Banner!"

DISCUSSION QUESTIONS

- Why did people first think of the telephone as a toy?
- Why do you suppose people took so long to accept the telephone?
- In the early days, what groups of people benefited most from the use of the telephone?
- How did the telephone begin to change people's way of life?

Activity 2: Selling The Telephone

We know that people tend to be set in their ideas and ways of doing things. To convince them to change is often difficult, if not frustrating. Think of how hard it is, sometimes, to talk your parents into letting you try to do some things your way!

In this activity, class members will take the role of persons living in the 1880's.

Procedure

- You will work in pairs and present a short dialogue. One student will take the role of a salesperson, and the other student, one of the roles listed below.

- **Roles:**

baker	owner of horse stable
banker	restaurant owner
teacher	farm wife
telegraph operator	farmer
messenger boy	housewife and mother
seamstress	minister
postmaster	theatre manager

- **Task of Salesperson.** The salesperson will develop a "sales pitch" directed to one of the role characters. You must try to convince that person that the telephone is necessary in his/her home or business. In the "sales pitch" consider the following:
  - — Show how the telephone will help them in their daily activities.
  - — Show that the telephone will not disrupt their lives.
  - — Show how one can easily adjust to using the telephone.

- **Task of the Role Characters** Try to imagine the kinds of activities you take part in each day. Remember you are living in the 1880's. Develop arguments for not wanting or needing a telephone. Consider the following ideas.
  - — You are quite content doing things the way you have always done them.
  - — The telephone might make your life less pleasant in many ways (e.g., There is no way to stop people from calling you. You can be interrupted any time, etc.)
  - — What are some of the problems in using the early telephones?
  - — What types of drastic adjustments might you have to make in your business or home?
  - — Will the telephone make your day more leisurely or hectic?

- Each pair of students will present its dialogue to the class. The conversation should last for about five minutes.

- At the end of all the presentations the class will select:
  1) the most convincing "sales-pitch" *and*
  2) the most convincing argument for not installing a telephone

Reading 2: The Telephone — A Communications Network

The development of telephone communications involved more than simply inventing a device to transmit and receive sound. It required the development of a system so that a person could make calls to many people and make calls to more distant places. Similar to automobile travel which depended on the construction of paved roads and gasoline stations, telephone communications depended on an organized system of operations. Buying a telephone did not give one instant communications! To call a distant place required wires for transmitting the call, switchboards to make connections and "exchanges" where one telephone company could be connected to another. A matter seemingly as simple as telephone poles created new concerns. Permission had to be obtained from the property owner to place telephone poles. With telephone poles needed for every 130 feet of wire, entire forests were required to meet the demand.

People had to be trained to put up and repair the lines, build the telephones and switchboards as well as maintain the switching equipment. Surprisingly, one of the critical problems in the early days was training telephone operators. In those days before the dial phone, each call was made by signaling the operator who then connected the lines. Since telephones soon put many telegraph messenger boys out of work, they were naturally hired to operate the switchboards. These young boys found the pressures of working a switchboard intense, yet they were expected to be polite at all times. How different it was from delivering messages! Hibbard described their experiences as follows:

"Put yourself in the place of a boy of fifteen years or so, eagerly answering a call. You hear a voice bark out, 'Hey there, gimme my office' – or 'No. 10' or whatever may be wanted – 'and hurry up about it.' You then leap to the next call and hear someone roar at you, 'What's the matter up there? Is everyone asleep?' Then perhaps on a third call someone shouts, 'See here, young feller, if you don't get a move on I'll report you.' If these things happened to you, would you not get hot under the collar, see red and 'sass' back? I ask you. Well, so many of these boys did 'sass' back that telephone exchanges became, in many places, exchanges of loud and lurid language – to such an extent that discipline was impossible and boys had to be fired almost faster than they were hired."[1]

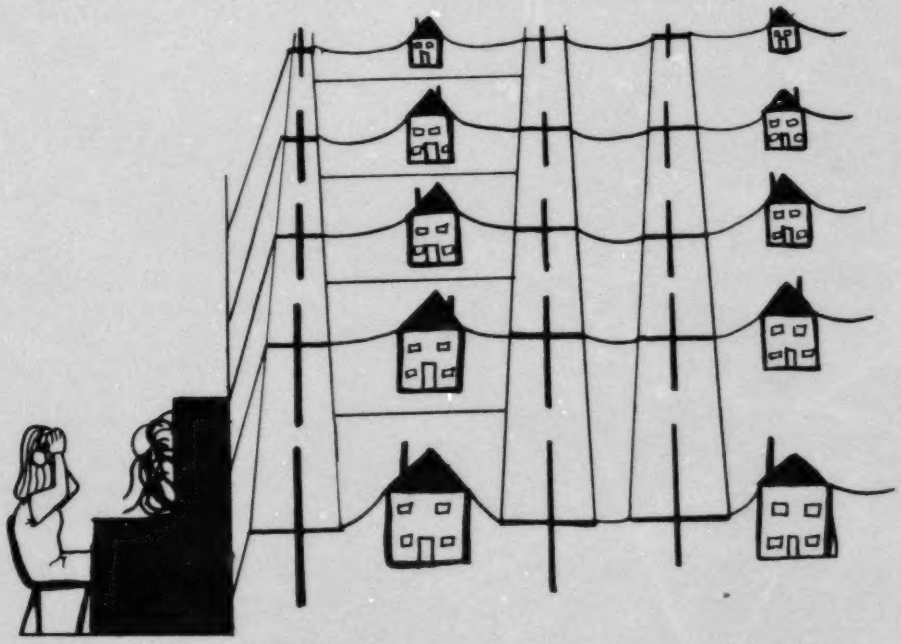
The boys were soon replaced by young ladies. This opened a new career for women. Operating a switchboard was considered a "proper" type of job, and schools were set up to train the girls in correct telephone etiquette.

Extending the Network

To expand the telephone network required more exchanges and connecting lines. Investors were also needed to provide money for such major constructions.

Alexander Graham Bell's invention was financed by Thomas Sanders, a prosperous leather merchant, and Gardinar Hubbard, a lawyer. These three men and

[1] Angus S. Hibbard. *Hello, Goodbye: My Story of Telephone Pioneering*. A.C. McClurg and Co., Chicago, Illinois



Telephone switchboard to make connection and exchanges

Thomas Watson, Bell's assistant, became the owners of the patent rights to the invention. They were the Bell Patent Association.

Hubbard was a lawyer for a shoe machinery company. This company did not sell its machines but simply rented them out. For each pair of shoes produced by the machine, the company collected a small fee. This proved to be the secret to the company's success. Hubbard wanted the same idea applied to the new telephone venture. In this way the group could more easily carry out their grand visions of a system of telephone lines spanning the country and crossing continents.

The Bell Patent Association, at first, manufactured the telephones and leased them to telephone companies who, in turn, leased them to their customers. But they quickly found it impossible to keep up with orders for the telephone. By the end of 1877 there were already 778 telephones in use. The company then, for a fee, granted licenses permitting other companies to enter the telephone business.

The first company licensed to establish telephone business was the New England Telephone Company in 1878 which could operate lines in the New England area, use the Bell patent to manufacture telephones and license other companies. However, it was allowed only to lease the telephones to their customers. The Bell Telephone Company was then formed to license companies outside the New England area. These two companies joined to become the American Bell Telephone Company in 1880 and later the American Bell Telephone and Telegraph Company in 1885.

The early operating companies were given licenses for either five or ten years. When these licenses expired, the corporation granted a permanent license and reduced the telephone rental fee ($10 per phone) in exchange for stock in those companies. Thus, the American Bell Telephone Company obtained a share in the ownership in these local companies, gaining income both from rentals and a share of the profits.

Local companies were permitted to operate only in their prescribed area. Long distance calls could be possible only if these exchanges were connected to one another. The question became, who would construct the connecting lines? The construction and operation of long distance lines required great sums of money. This was more than the existing American Telephone Company was allowed to raise according to its original charter agreement. A new company, the American Telephone and Telegraph Company, was formed to establish and operate long-distance lines and lines that interconnected the other companies. It was felt that this type of organization would be most efficient.

If many companies entered the long-distance business, there could be much confusion with each company using different operating methods and adopting different equipment improvements. A single system, however, would insure that future developments and line extensions would proceed smoothly.

Equipment manufacturing in the pioneer days of the telephone was also a case of great variety. Originally, all telephone equipment and apparatus was built by Thomas Watson in Charles Williams' telegraph instrument shop. But Watson was soon overwhelmed by the flood of orders. A number of other shops were engaged to assist in the production, and of course many of the local companies built their own equipment and receivers. Since the invention patents covered only the basic ideas of the telephone, the manufacturers were free to develop their own design styles and materials. As a result, no one company produced the same telephone. In some cases, the telephone instruments were of poor quality.

During this time, the other major telephone manufacturing company was the Western Electric Manufacturing Company and its associate, Western Union, the major telegraph company. They owned several important telephone patents developed by Elisha Gray and Thomas Edison. Through a series of agreement and stock purchases by AT & T the Western Electric Company was formed in 1882. Now the Bell Company and the Western Electric Company owned the majority of all the telephone patents. They could, thus, determine the design and materials to be used in all its equipment. However, the Bell basic patents expired in 1893 and 1894. A great number of "independent" telephone companies sprang up at this time, especially in areas where Bell-affiliated companies had not been established. Many of these were farmer lines in the sparsely populated rural areas.

Farmer lines were most often simple, home-built systems that connected one farm house to another. Others were small town companies formed by the local residents to communicate within their own community. Some companies, however, were established to compete directly with the Bell companies. In many places, it seemed that the Bell companies did not always provide good service, yet charged high rates. A number of commercial companies were in operation before the original Bell patents ran out because they challenged the Bell Company's wording of those patents. Equipment manufacturers also sprang up so they did not have to buy only from the Bell system and Western Electric. Offering lower rates and improved services, the new independents quickly gained customers and competed with the Bell companies.

The Bell subsidiaries in some areas such as the Central Union Telephone in Indianapolis charged businesses $72 a year and residences $48 a year; the independent company offered phones at $40 a year for businesses and $24 a year for residences. The number of independent exchanges grew rapidly. By 1902 there were 6,608 independent exchanges and 3,153 Bell exchanges, although the Bell system still had twice the

number of miles of wire. Responding to the competition, the Bell companies reduced rates in some areas to $54 for business and $24 for reseidential use. In other places, such as Pittsburgh, the rate for a one-party phone was $125 in 1906.

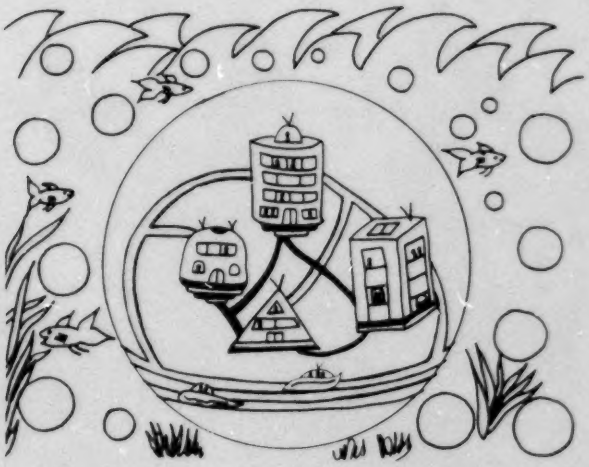
Some independents soon ran into difficulty because the fees they charged were too low. They found that to repair equipment or to enlarge exchanges was costly. And they, too, had to raise their rates. Others could not maintain high quality service. Customers had long waits before the operator answered to connect their calls. Telephone lines damaged by wind or snowstorms were not promptly repaired.

Many of the early companies were organized for quick profits. This created disillusion among the users who found that the telephone did not always serve them well.

An important change in the Bell system occurred when Theodore Vail was called back from his retirement in 1906. Although he had earlier directed the Bell system, his ideas differed from his business associates. He saw the telephone as a system that would make services available to everyone. The value of the telephone, he believed, would come through the expansion of telephone lines and the connection of major cities. Eventually the telephone would be accessible to the entire U.S. population. These ideas were strongly opposed by many businessmen of the day. They believed that the extension of lines was too expensive because of the large investment required. Putting profits into new lines and equipment meant that the stockholders would not receive their large yearly dividends. They felt that the stockholders should gain a profitable return from the money invested. With Vail's return, a rapid era of telephone expansion begun. Thus, Theodore Vails's idea of the telephone as a service system shaped the future of the telephone communications in the United States.

DISCUSSION QUESTIONS

- What are the advantages of a single company running the telephone system? Disadvantages?
- Why might it be important to have uniform telephone equipment?
- Rural areas were among the last to get full telephone service. Why was this the case?
- What are the advantages of renting the equipment instead of selling it?
- How does the idea of the telephone as a service system differ from the idea of the telephone as a piece of equipment? Why was this idea so important?



A scenario is story or description of a possible future — What could be

Activity 3: Scenes Of The "Future": An Exercise In Scenario Writing

Writing a Scenario

A scenario is a story or description of a possible future — what could be. In writing a scenario, one forecasts certain kinds of changes and tries to imagine the effects of those changes. A single change can bring about other changes. When one examines possible changes and tries to put everything together into a total picture, as in a scenario, one can begin to see how one event relates to another to create a possible future event.

Scenarios are often used as a planning guide. One may determine one's goals for the future and use the scenario to lay out the steps necessary to get there. For example, if one's goal were to establish a community in space, the scenario should describe how that community functions. The descriptions would include the number and types of people living there; the work that will be done; the kinds of food and shelter needed; the methods for obtaining supplies; types of leisure activity; the possible effects of living in outer space; and so on. Problems and needs begin to emerge, and the planner will then have a framework from which to work out the necessary details and consider the different ways to create a space community.

Scenarios are also used to examine effects of decisions. Different decisions lead to different futures. The scenarios, in this case, would describe where a particular decision will lead. By looking at that possible end result, one can perhaps better decide whether that is, indeed, the change one wants. For instance, one might decide that all the work in the space community will be performed by robots. What then will the human residents do? With all that free time will they pursue other creative activities such as painting, composing music, writing novels, and so on? Will there be enough activity in that small area to keep the people entertained? Will they become bored and lazy? What are the advantages of being served by robots? Disadvantages?

Science fiction is one form of scenario writing. Some writers base their scenes on today's current trends and try to project what the future holds if the trends continue. Jules Verne in the 1800s predicted submarines, airplanes and spaceships for the future. Other writers suggest new and different styles of living such as societies where everyone is identical and people live free from conflict and competition as in Aldous Huxley's *Brave New World*. Others use their stories to point out in a more dramatic way the problems of our current society. In all cases, science fiction writers are testing new visions by letting their imagination explore different and possibly unusual ideas.

In this scenario writing exercise, it is hoped that you will be more like a science fiction writer. Free your imagination and speculate a little. Do not be bound by "what it is like now" (therefore this must be the way it will be) but think of "what it could be"! However, like good science fiction writers, you must try to be as convincing as possible.

Here are some helpful questions to guide you:

- What are some of the known facts or trends which might support your "far out" idea?
- How well does the story hold together? Does one idea relate to another to build a complete story?
- Do you have any new suggestions about how a difficult problem might be solved?
- Are your arguments well presented? How might you make your ideas more believable?
- Is it intriguing to the reader?

In the reading "Early Uses of the Telephone," you found that in the past people viewed the telephone quite differently than we do now. As with many inventions, it is hard to imagine all the ways that it can possibly be used. Many of the ideas or predictions came true and others did not. People tend to predict changes based on what they have experienced. However, as telephone communications became widespread, other social changes began to take place. What may seem very different then is very commonplace and accepted today.

This scenario writing exercise will give you the chance to be a "futures forecaster." You, however, will have to think as a person living over 60 years ago and forget what you know today about the telephone. In doing so, you may come up with some new and very different ideas. Perhaps the telephone could have developed along a different path.

The following is a list of scenario themes. Select one to develop into a two or three-page scenario. Put yourself back in time and try to imagine what it was like then. Your scenario should be a complete story. You can make up characters and describe how they might act in that situation.

Scenarios:

- *Suppose that in 1910 the farthest distance that one could communicate by telephone was 1,000 miles. You are a clothing manufacturer in New York and want to establish 10 retail stores around the country, especially on the West Coast where the population is growing rapidly. Write a scenario describing where you would locate the stores and how you would keep in contact with the stores, filling their orders, keeping them informed about the new styles, price changes, etc. There may be some stores that you cannot call directly.*
- *Imagine that in 1910 you are living in a rural part of the U.S. The nearest neighbors are several miles apart. Schooling is a major problem for the children of the area. One difficulty is deciding on a location that is an easy walking distance for all the students. Furthermore, since this is a farm community, all the children are needed to help with the daily farm chores. Chores often take up most of the day. You wish to propose the establishment of a school conducted by telephone. Write a scenario describing how you might accomplish this. Keep in mind that this rural community does not have a telephone system (i.e., interconnecting lines, telephone exchanges, etc.). How will you convince the parents that the children can be taught over the telephone? How might students give reports? How will the teacher grade papers and tests? In what ways can a teacher tell that the students are paying attention and understanding the lesson? How many students can be taught by telephone? Who will operate the switchboard? If additional people are required to run the school, will the parents be able to afford the salaries of the new employees?*
- *Early articles describing Bell's telephone invention often offered suggestions on possible uses. In an 1876 issue of* Nature *it was suggested that the telephone could be used to provide entertainment. For instance, if one were to give a dance, one would not need to hire musicians but simply subscribe to a telephone service that would transmit the musical program. This idea was adapted in part in Budapest in 1893 where the telephone provided news, music and store advertisement. Write a scenario describing a community where telephones are used for only one-way communication. What types of information might be transmitted? Who would be transmitting? Who in the community would be interested in subscribing? How might such a system operate? Will switchboards be necessary? (Does this system resemble anything that we have today?)*
- *When Bell's first patents ran out, there was a sudden rush by many business groups to set up independent companies and establish their own exchanges. Suppose that a city such as New York at the turn of the century were served by 25 different exchanges, each exchange serving a different business or residential area (ethnic groups). The police and fire departments have separate exchanges. Write a scenario describing a day in the life of a businessman in the shipping business, a doctor or fireman or policeman. It is possible, however, for persons in the business district to subscribe to different exchange services. In this case, each exchange system requires a different phone.*

- *How might telephone communications have developed if Bell, Watson and their investment group had simply pursued one aspect of telephony – the manufacturing and selling of only the telephone instrument, but not the service system. If this decision had been made, customers would purchase the phone and string their own lines to connect to persons and places with whom they desired to communicate. Write a scenario describing a community where each person had to provide his own lines. Who would be responsible for repairing the lines damaged by a snowstorm? Would telephone communications be considered more of a luxury or plaything? Who might be the most frequent users of the telephone?*
- *Party-lines, where a number of users shared the same lines, was the common form of telephone service in the early days of telephony. This type of service still exists in many parts of the country, especially in the less populated rural areas. Suppose that the telephone company established the policy of party-line service only to reduce the cost of telephone wire installation. It further decided that a single city block of businesses or residences would be served by the same line. Write a scenario describing the effects this would have on personal lives and business activities of the telephone users. Would one be as willing to discuss one's personal problems as freely over the telephone? Would clients be willing to discuss their pending court case with their lawyers over the telephone? How much business would a businessman conduct over the phone if he knew that his competitor might be listening on the other end? What if you were expecting an important phone call from a distant relative and your neighbor monopolized the phone for hours, gossiping with other neighbors? Are there any advantages in having a party line? Would it be practical to set up a time schedule which limits the time when one can make calls?*

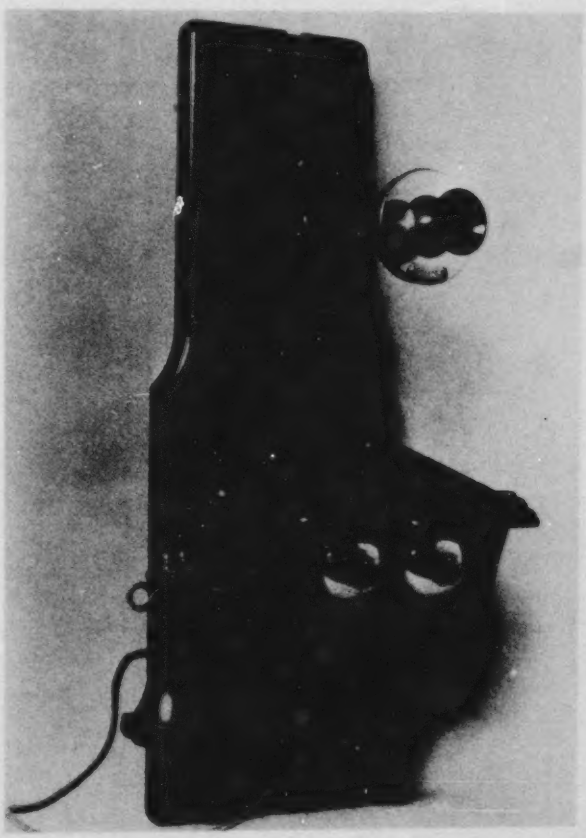
Reading 3: Changes In Telephone Technology And Growth

In the previous reading you learned that telephone communications required an organized system of connecting networks. Developing the system was a long and complicated process. The type of decision made affected the way in which the system took shape. If other decisions had been made, our telephone system today might be very different.

Other important factors also affected telephone communications. These were the technological changes, a series of new inventions, discoveries and improvements.

The most visible change in telephone communications was the telephone instrument itself. If you were shown a model of the first commercial telephone, you might not guess what it did. The first phones were rectangular "boxes." The same opening was used both for talking and listening. Imagine such a box on your desk and your having to shift your ear and mouth as you carried on your conversation! Since the early sound transmissions were of poor quality, it was necessary to get very close to the instrument.

The clumsy box was shortly replaced by a hand-held instrument. This was the "butterstamp" receiver (so-called because it resembled the butterstamps used to form attractive pieces of butter for table use). It, too, was used for both listening and speaking. And, if you had two of them connected to the wall box, you could use one for listening and one for talking.



A major problem in early telephony was the quality of sound. The principle of the telephone was based on transforming sound vibrations by moving magnets into electric currents carried by a wire. At the other end, currents were converted back into sound. The amount of current generated depended on the loudness of the sound such that some sounds would not be carried as far as others. But sound itself moving the magnets did not create enough current for longer distances. Current had to be supplied from another source such as a battery. In addition, the amount of current must be controlled so that, as the level of sound changed, the current remained constant. This problem was solved by placing a material between the transmitting unit that would vary the resistance, allowing more current to flow when the sound was weaker. Thomas Edison's discovery of using granular carbon proved to be the most satisfactory of the many different materials tried. Nevertheless, there were difficulties in using granular carbon. When the particles of carbon packed together the resistance changed. When this occurred, the telephone user had to frequently shake the transmitter to get it working properly again. In 1890, Anthony White invented what was known as the "solid black" transmitter. This type of transmitter not only improved the efficiency of using the telephone but also made it easier to manufacture telephones in large quantities.

The distance of early telephone communications was also limited. The farther the current travelled the weaker it became. The first telephone lines were the same iron wires used in the telegraph. Good sound transmission over these wires was possible only for short distances. The iron wires rusted and corroded readily, causing much static and interfering noises. This difficulty was solved by using a specially hardened copper wire. However, copper was expensive. Increasing the distance of the line required copper of increasingly larger diameter. Such wires were heavy and easily damaged by wind and ice storms. Nonetheless, with copper wires and special methods to reduce electrical disturbances, it became possible to communicate between New York and Chicago in 1892. By 1897, there was service between New York and Omaha, a distance of 1300 miles! This, however, seemed to be the limit of telephone transmission until new advances came about.

Developments in the following years included the use of cables consisting of several thin wires wrapped with protective materials. Cables also carried more lines which became a necessity as the number of telephones, increased. However, the early cables were good only for short distances. The weight of cables strung on poles and across building tops was staggering. This was especially true in the large cities where many more telephones were installed. As a result, underground cables in duct systems were installed. But the underground cables added to the cost of telephone service. Thus, cost and limited distance were major problems for the telephone in the 1900's.

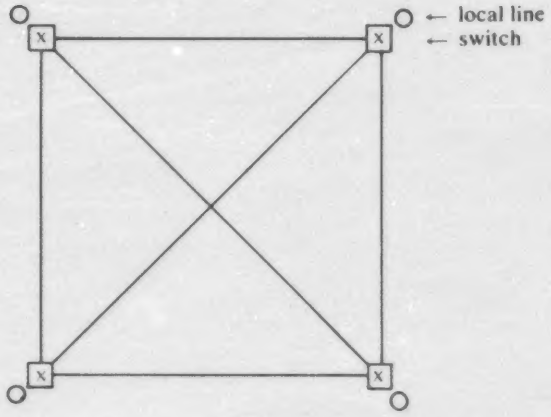
Another important problem to be solved was how to get a person to answer his/her telephone call. In the very early days when the lines were simply connected to two users, one only had to pick up the phone and shout a greeting to the other end (granted, of course, the other person was close to the phone). The establishment of a central switching system made it possible to place calls to many people. Therefore, better ways of notifying the operator and caller became necessary. One of the first signaling devices consisted of a small hammer placed so that it struck the edge of the vibrating disk of the transmitter. This was the "thumper," but its tapping sound was faint and not particularly good for attention getting. Other types that followed were electric "tap bells," telegraph sounders, and a buzzer that produced harsh grating soundings which customers found most annoying. T.A. Watson finally solved the problem with the call bell, consisting of two bells with a hammer between. When the bells are alternately magnetized, the hammer vibrates between the belts creating the ringing sound. To provide electricity for this system a hand crank generator was attached. In order to make a call with the early telephone, one turned the crank electric generator to set off the operator's bell, the operator answered, switched the connections, and rang the other end.

To keep the cost lower, several customers often shared the same line. Each customer was then assigned a ringing code using various combinations of short and long rings. Thus, receiving a phone call was not a private matter, for everyone else on that party line knew who was being called. And one would certainly not want to share a line with a doctor who might be called at all hours of the night! In 1896, a system was devised where phones on the party line were rung selectively — thus only the phone to which the call was placed rang.

As the number of telephones increased the problem of connecting the many customers became critical. The first phones were connected to each other by a single telephone line as shown in the following diagram:

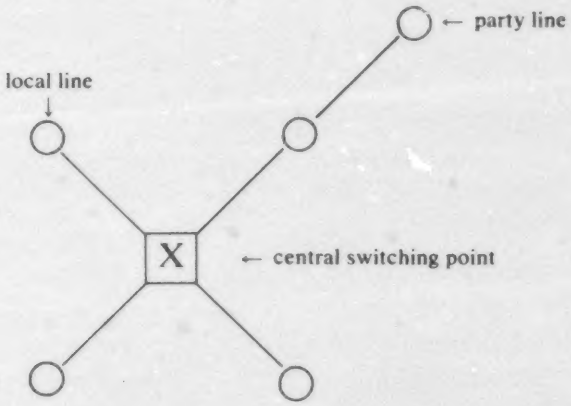
In such a system any person on the line could pick up the telephone and listen in on the conversation between two other parties. This would be an advantage if one wished to hold a local music concert in the evening and had no way of meeting together. It certainly afforded no privacy if one wished to keep any secrets. Furthermore, if parties #1 and #3 were long-winded, a person wanting to make a call had to be patient.

Local station switching was a possible alternative:



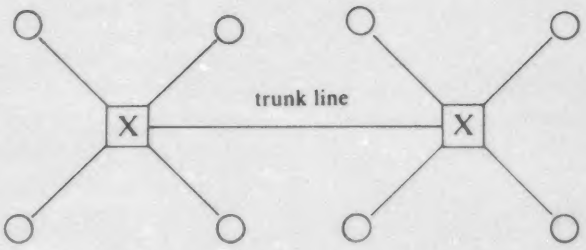
In this system each phone was connected to the other and contained a switch, making it possible to connect with each of the phones on the line. With a small network of telephones this system was practical but became expensive and awkward when there are many telephones in the network. Also, a separate line was required for each telephone connection. So if one wanted connections to ten different phones, one would have ten separate lines leading from that one phone, each connecting a separate phone.

Central switching was soon adapted from telegraph technology to make telephone communications more practical. In central switching, each local line is connected to a central switching point which in turn made the connections:

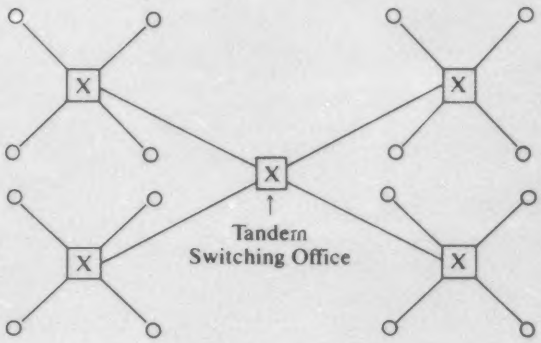


With central switching one needs only a single line leading from one's phone to the switching station. This system made it possible to contact many more parties.

Central switching points could then be connected to others through trunk lines?



This system could be expanded to a tandem switching point where trunk lines were switched, and from there the local lines were switched:



Telephone operators upon receiving a connection request would determine the trunk line to be used, connect that trunk line and pass the information to the operator of the local trunk line who then completed the call.

In a large city with many telephones this could be a very complicated process. With many calls being made, more operators were required, but there was only so much room in front of a switchboard! A solution was the development in the 1880s of duplicate boards. Each operator would be assigned calls from a specified group of telephones. However, all other lines in the exchange were located on her board. With this duplicate board the operator could connect the call directly without having to go through another operator. Nonetheless, with operators having to connect each and every call, many operators were needed. In 1902 it was estimated that for every 1000 telephones 22 operators were required. If operators still connected calls today, we might need over 900,000 operators to handle calls made by the 150 million telephones in the United States.

These were only a few of the many changes that took place during the early years of telephony. Each new development, however, contributed to making the telephone easier to use, increased the distance of telephone transmission, and allowed more telephones to be connected to the system.

Activity 4: Developing Your Telephone System — The Delphi and Cross Impact Matrix Method in Planning Strategies

Overview

Forecasting and planning for the future is always easier when one can step into the past as did the main character in *A Connecticut Yankee in King Arthur's Court* by Mark Twain. This first exercise will present you with a somewhat similar experience. You will be asked to put yourself in the role of a person living over 65 years ago and to make decisions based on what you think might occur.

The decisions that you make do not necessarily have to follow what actually happened in history because your decision, had you been the decision maker 65 years ago, could have changed history. Forecasting future activities often includes taking the needed steps to make that future happen. This is different from a prediction of an unavoidable event. For instance, in 1910, a person could predict the 1943 Paracutin volcano eruption in Mexico. That event would have occurred despite any decisions or actions that might have been made. In other words, people could not prevent the volcano from erupting; the event was beyond control. However, knowing future possibilities does put you in a better position to take or avoid certain actions — even those beyond your control. If in 1940 you have knowledge of the coming volcano eruption, you certainly will not plant a field or build a house nearby.

Your task in this exercise will be to use what you know, make projections and predictions from the information and arrive at some decision on the course of action to be taken.

For example, if you predicted that some day there would be a telephone in every U.S. household, some of the questions that you will need to answer might include:

- On what date will that occur?
- What changes in the telephone design are needed to make it easier and more convenient to use?
- How should a person using the telephone be charged and how low should the rate be before everyone can afford a phone?
- Will everyone want a phone? What will make the telephone more of a necessity than a mere convenience?
- Might there be other inventions that would make the telephone obsolete?
- What new types of companies need to be formed to provide the service and the equipment?
- What new uses might we find for the telephone?
- When nearly everyone has a telephone what new types of businesses can be developed that could not be possible in the pre-telephone era?

Living in the 1980s, you happen to know a great deal about the telephone and the enormous changes that occurred since Bell presented the first primitive sound transmitting device. In this exercise, you will again be asked to put yourself back in time to the year 1910, 34 years after the invention. Pretend that you only know what a person then knew about the telephone. Consult the 1910 *Telephone Fact Sheet* (pp. 19-20) for more specific details.

You and your classmates will conduct two rounds of a Delphi Survey to aid you in making certain decisions. From the results of the survey and preferences you will analyze the effects using a "cross impact matrix analysis." After examining the effects and the importance of those effects you will describe your decision and its effects in a "future scenario."

The Delphi Survey

The Delphi Survey is a method of gathering and refining opinions from a group of experts. The name Delphi comes from the ancient Greek city, Delphi. It was there that the Oracle resided, and people journeyed from afar to seek its forecasts and advice. The Delphi method, today, is most often used with other forecasting techniques to study the future.

Forcasting, however, is not the same as consulting an oracle who supposedly knows the future in advance. In forecasting, information is gathered and studied to determine the possible ways that future events might occur as well as what changes could take place to make an event happen. For instance, weather forecasters do not simply make guesses; they chart and calculate air pressures, wind directions and amounts of moisture. Examining the possible forecasts, they then make a prediction about the weather for the next day or next week. The accuracy of their prediction depends on how much information they have, how well they use that information and how well they understand the natural forces which produce weather patterns.

The Delphi Survey is basically a series of questionnaires presented to a panel of experts who then indicate their *opinion, preference,* or *judgment* on those questions. The idea is that a good estimation of a situation can be obtained when many persons are asked to provide advice. When the panelists complete the first set of questions, known as Round #1, the moderator or manager compiles the answers and summarizes the results. The results are then presented to the panel.

After they examine the results, they may wish to change their first answer or stay with their original choice. The questions are presented again in Round #2 and so on until some agreement has been reached. Panelists are to explain their choices.

By presenting the questions several times the panelists have a chance to re-think their own ideas as well as the ideas of others. Each panelist works independently and does not publicly announce how he/she responded to the questions. Anonymity is an important characteristic of the Delphi survey. It allows one to freely express one's opinion without being influenced by others.

A moderator or manager serves to organize and present the survey results.

Conducting the Delphi Survey

The setting and problem:

. . . The year is 1910

. . . Middletown is a small midwestern farming town. Population: 4,000

. . . Telephone service has not been established.

. . . The major telephone company in the state has no plans to build an exchange here, because it does not see a potential for profits. (The town is small and the houses are far apart. This would mean having to string many miles of lines just to serve a few people.)

. . . Can the residents be interested into getting together to form a telephone exchange?

. . . How can money be raised to put up the lines and build the exchange? Sell stock? Local taxes?

. . . Who will operate the telephone system? Private company? Town government?

Student Instructions

• Each person in the class will take the role of a businessman in the town. Your final task will be to present a proposal on how to best develop a telephone system in your town and how that system will operate.

• As "experts" you will begin by indicating your preferences in the Delphi Survey. The survey is designed to help you make decisions about the desired future events and guide you in designing your project. (You will conduct only two rounds.)

• The opinions of everyone will be polled and summarized. This summary information will be analyzed. The items that the majority have agreed upon will indicate the type of system most preferred.

• You will have to consider the many factors that will affect the establishment of a telephone system. Consider also the questions: What factors are most important? What changes will come about as a result of your preferences? These questions will be more completely discussed in the *Cross Impact Analysis*.

Delphi Survey, Round 1

• Your teacher will distribute the *Delphi Questionnaire Form* for you to use in completing the following questionnaire. (Do not write in the booklet.)

• Complete the questionnaire according to the directions given. Do not put your name on the paper as the responses should be anonymous.

• For each choice made, explain on the Survey form the reason for that choice. (i.e., What thoughts came to mind when you made your choice — The most efficient way to run the company? Convenience for the user? Increasing communications in the community? Increasing communications with the other parts of the country? Provide a good return on the money invested by the company shareholders?)

• A moderator or small committee will compile the survey results. Using a new Delphi Questionnaire Form, they will tabulate the number of times a given response was ranked first. The response which ranked first most frequently is the one preferred by the panel. If time permits, the committee may also wish to find out how the other responses were ranked. The committee should summarize the reasons given for selecting a particular response.

Fact Sheet: Telephone Communications In 1910

- There are now approximately 82 phones for every 1,000 persons in the United States.
- Alexander Graham Bell's original patent expired in 1893. There has been a rapid rise in the number of independent telephone companies. Independent companies number nearly 24,000.
- Independent companies operate over 3 million telephones, while the Bell companies operate about 4 million phones.
- Most independent exchanges (not part of the Bell system) serve small local areas. They connect with only a few exchanges. Those exchanges are usually within a short distance of one another. High costs of cables and problems of noisy circuits make long distance connections unprofitable in areas outside the large cities.
- The White House has installed its own telephone exchange.
- Long distance lines of the Bell system connect the major U.S. cities in the east. The invention of the "repeater" which strengthens the current passing through the lines has made longer distance lines possible. The longest line, that between New York and Denver, is near completion.
- Making a long-distance call is still a complicated procedure. As many as four to five operators are often required to make the necessary switches through the different exchanges. The caller first notifies the operator and then hangs up to wait while the operator locates the appropriate lines and contacts the desired party. When the call is finally connected, the operator then times the length of the call to determine the bill.
- Most large and medium size hotels have installed telephones in their guest rooms.
- A few exchanges are using a partial automatic "dial" system. However, it is the operator who "dials" the call when the caller gives her the number.
- For every 1,000 telephones about 20 operators are required to handle the switchboards.
- Underground long distance cables are being installed between some areas. This prevents the problem of sleet storms shutting down communications between cities. A shutdown occurred between New York and Washington, D.C. during the inauguration of President Taft.

- In Budapest, Hungary, the telephone is used to broadcast news and musical entertainment. To receive scheduled programs a subscriber simply rents a wooden disk speaker for one's home.

- Major cities continue to use the telegraph system for signaling police and firemen in emergencies. It is felt that the signal call box is quicker and more efficient since the help of an operator is not required. Furthermore, the coded telegraph signal is automatically recorded at the central station and includes information with date and time.

- Businesses are the major users of the telephone.

- Many cities and towns have several telephone companies operating in the same area. In such cases, one frequently finds grocers, butchers, druggists and doctors using at least two separate telephone systems. If they use only one system, they would surely lose the business of persons who subscribe to the other phone system.

- Telephones have become especially important to doctors, particularly those in rural areas who have to travel great distances. The telephone operator, in a sense, has become a doctor's office secretary, keeping track of his whereabouts and emergency calls.

- Coin operated telephones are available for public use in numerous locations in the larger communities.

- In some cities, such as San Francisco and Chicago, coin box telephones are popular in residences and small businesses. This was one method to attract people to use the telephone. One was not required to pay a high subscription fee. Such a phone is installed for the convenience of neighbors and customers. One pays each time one makes a call.

- Party lines are very common. Some lines have up to ten parties on a single line.

- Some factories and businesses use a private telephone system in their buildings so that the managers and workers can keep in contact without the use of messengers.

- Most telephone exchanges are in large towns and cities. Developing rural lines is more expensive. Often in rural areas, farmers get together to construct their own lines, cutting and putting up the poles and stringing wires. The switchboard would be located in one of their homes, operated by the family members.

Delphi Questionnaire: A Telephone Exchange for Middletown

Below are eleven statements (#1-11) to be completed by one of several possible endings. Your preferred choice should be made in the following way:

Step 1: **Priority Rating.** Read each statement and the possible phrases for completing that statement. Indicate how important you feel each of the choices to be by placing the appropriate number of stars next to the letter **on the response form** that corresponds to the letter of the phrase.

**** — extremely important
*** — important
** — slight importance
* — no importance

Step 2: **Ranking.** Arrange the statement endings from most important to least important. For example, if you feel that "d" is most important it should be ranked #1. Write that letter in the appropriate space next to rank #1. Do the same for rank #2, and so on, until all the possible choices have been ranked.

How Important

1. **Purpose of the telephone exchange in the town:**

____ a) to make a handsome profit quickly so that local investors (shareholders) will be pleased they invested their money in this new venture.
____ b) to make it easier and faster for the business man to conduct business.
____ c) to summon help in emergencies (i.e., police, firemen, doctor, etc.)
____ d) to make it possible for the townspeople to visit with one another without having to travel.
____ e) to obtain news and information (e.g., election return, time, weather reports).

Rank #1____ #2____ #3____ #4____ #5____

2. **Telephone service should first be made available to:**

____ a) the people who can afford to subscribe to the service.
____ b) the people who have greatest need for a telephone (e.g., invalids, doctors, drugstores, town officials, etc.).
____ c) everyone in town and paid for by local taxes.

Rank #1____ #2____ #3____

3. **The company will obtain the equipment by:**

____ a) renting from the Bell system because the equipment is standardized and lines can be readily connected with other communities using Bell equipment. Furthermore, the rental fee will include the cost of service and repairs.
____ b) buying from independent equipment manufacturers. People will own their telephones.
____ c) forming its own manufacturing company to produce equipment for its own needs.

Rank #1____ #2____ #3____

4. **The fairest way to charge for the telephone service will be to:**

____ a) charge a single yearly fee such as $150 for businesses and $100 for residences.
____ b) charge the user for the number of calls made no matter how long the user is on the line.
____ c) charge for the length of time the caller is on the line.
____ d) charge according to the distance between the caller and receiver. For instance, calling one's neighbor will be less than calling from the center of town to a person in the outskirts of town.
____ e) split the cost of the call between the caller and receiver.

Rank #1____ #2____ #3____ #4____ #5____

5. **Repairs to telephone instruments should be:**

____ a) paid by the user as needed. In this way people will be more careful in handling the telephone and would not be paying for service they do not use.
____ b) provided by the company which will set

aside part of the subscription fee for possible repair service.

____ c) a service provided by the town and paid by taxes.

Rank #1____ #2____ #3____

6. **If the telephone lines, poles, etc. are damaged by snow and ice storms, for instance, the cost for repairs should be:**

____ a) assumed by the company which has included a repair service fee as part of the total subscription charge.

____ b) paid by those who are connected to that particular line.

____ c) shared among all the subscribers who will then be billed by the company for that particular repair service. In this method one pays for the service that is actually used.)

Rank #1____ #2____ #3____

7. **The telephone operators should be:**

____ a) the telegraph and office messenger boys who have lost their jobs as messages will no longer need to be hand delivered.

____ b) persons who have had previous training as telegraph operators.

____ c) young women, because in other telephone exchanges they have been shown to be more courteous and efficient.

Rank #1____ #2____ #3____

8. **If it is difficult to raise enough money in the beginning to build an exchange to serve everyone in the community and to run telephone lines to every store, office and house, the company should limit the service by:**

____ a) establishing lines only in the business district.

____ b) offering only party-lines which would reduce cost.

____ c) establishing lines to connect with the neighboring towns and place the telephones in public places.

____ d) establishing lines in the part of town where there is the greatest number of people willing to subscribe to the telephone service.

Rank #1____ #2____ #3____ #4____

9. **The telephone exchange should list the subscribers:**

____ a) name only as this is a more personal type of service. In a small town the operators will know everyone by name anyway. It will be easier when people don't have to look up a number each time they make a call.

____ b) assigned telephone number so that the operators will not have to memorize all the names in the exchange to make the connection.

____ c) house number and street name so numbers don't change when people move.

Rank #1____ #2____ #3____

10. **The telephone company can best serve its subscribers by:**

____ a) offering low taxes.

____ b) establishing long-distance lines to connect with other towns.

____ c) connecting calls quickly and does not keep the caller waiting.

____ d) adopting new telephone improvements quickly so that the calls can be made easily, the conversation will not be interrupted by other noises, the calls come through loudly and clearly, etc.

Rank #1____ #2____ #3____ #4____

11. **The telephone company should be:**

____ a) run as a private independent company with the company officers making decisions for its investors.

____ b) run as a community service department of the local town government to serve the needs of the community.

____ c) run by the subscribers such as a mutual company or a cooperative where each subscriber helps to decide the type of service and equipment one wants and how to best provide it.

____ d) run as part of the Bell System which can provide engineering expertise and long distance connections to other parts of the country.

Rank #1____ #2____ #3____ #4____

Delphi Survey, Round #2

- After the first Delphi Survey has been completed and the results summarized, you will fill out the survey a second time. Based on the results of the first survey, you may or may not wish to change your responses. Do so, if you wish.

- For each choice that you make, again explain on the survey form why you made that particular selection. (i.e., What thoughts came to mind when you made your choice — The most efficient way to run the company? Convenience for the user? Increasing communications in the community? Increasing communications with the other parts of the country? Provide a good return on the money invested by the company shareholders?). If you made any changes, explain why you did so.

Summary of Delphi Survey, Round #2

- The moderator will present the results of the second round.

- What items did most of the experts panel agree upon? On which items was there greatest agreement?

- What do you suppose were the main concerns of the panel?

Cross Impact Matrix Analysis

The Cross Impact Matrix Analysis is used to examine the effect of one decision on another. The analysis will be done in a chart form. This chart will be completed as a class discussion exercise or in small groups.

Student Instructions

- Six statements from the Delphi Survey will be used for the Cross Impact Matrix. Statements 1, 2, 6 and 11 should be included. Select two more statements to bring the total to six.

- List the six statements in both the column and row headings on the Cross Matrix Impact Chart. (The chart can also be reproduced on the blackboard or overhead transparency.)

- Consult the Statement Abbreviations List for an abbreviated statement.

  For example, the main idea of statement 1 is the *purpose* of the telephone company. The statement is then completed by one of the three item choices: a) profit, b) business, c) emergency, d) social or e) news/information. The completed statement is determined by the results of the second round of your Delphi Survey. Which item was preferred by the majority of the panel? If item b was preferred, then statement 1 should be entered on the chart as *purpose – business communication.*

Follow this procedure for all six statements. The first statement should appear in box 1 of the row heading and box 1 of the column heading; the second statement in box 2 of the row heading and box 2 of the column heading, and so on, until all 12 heading boxes are filled.

- The purpose of this Cross Impact Matrix Analysis is to examine how one *preferred outcome* affects another *preferred outcome*. It attempts to answer the question: If I want this to happen, how will it affect another goal I desire? For example, if the goal of the telephone company is to make a quick profit, will the rates be low?

The answer is given as *yes* or *no*. This is indicated in the following way:

Yes = 1
No = 0

- The items listed *down* the column represent the preferred outcome. The preferred outcome is then compared with the other items listed *across* the matrix chart. You will compare the preferred outcome with each of the items listed across one at a time and record "1" or "0" in the appropriate box.

- When you make each comparison you will be asking the question, 'If this were decided, will it bring about this other preferred item?" Or, "If this were done, what is the chance that the other will also happen?"

An example of a completed Cross Impact Matrix Chart is shown on page 26. The example of preferred choices are as follows:

- *Purpose of the telephone exchange in town is to make a handsome profit quickly. (1-a) (purpose – profit)*
- *Telephone service should first be made available to people who have the greatest need. (2-b) (availability of service – need)*
- *The company will obtain the equipment by buying from an independent equipment manufacturer. (3-b) (equipment – ownership of equipment)*
- *If the telephone lines, poles, etc, are damaged, the cost for repairs should be paid by those who are connected to that particular line. (6-b) (disaster repair – user)*
- *The telephone company can best serve its subscribers by offering low rates. (10-a) (type of service – low rates)*
- *The telephone company should be run by the subscribers as a mutual company. (11-c) (organization of company – mutual company)*

Your completed statements are to be entered on the chart using the abbreviations found on page 24.

Statement Abbreviation List: The following are abbreviations for the Delphi Survey statements. Use these abbreviations in place of the entire sentence in the cross Impact Analysis Chart.

1. Purpose
   a) profit
   b) business communications
   c) news and information
2. Availability of service
   a) ability to pay
   b) need
   c) everyone
3. Equipment
   a) rental of standardized equipment
   b) ownership of equipment
   c) produce own equipment
4. Rate Change
   a) flat rate
   b) call units
   c) time on line
   d) distance of call
   e) calls made and received
5. Receiver Repair
   a) by user
   b) by company
   c) by town
6. Disaster Repair
   a) company service
   b) by user
   c) pro-rated among all subscribers
7. Operators
   a) former messengers
   b) experienced operators
   c) women
8. Line Construction
   a) to businesses
   b) wider service but party-lines
   c) intertown connection
9. Phone Listing
   a) name only
   b) number assignment
   c) house number
10. Type of Service
    a) low rates
    b) long distance service
    c) efficient call connection service
    d) improved transmission (sound and distance)
11. Organization of Company
    a) private independent company
    b) local government control (i.e., public utility)
    c) mutual company
    d) Bell subsidiaty

CROSS-IMPACT MATRIX CHART: Example

IF THIS DECISION WERE MADE,

THEN THIS OUTCOME WILL OCCUR:

Statement: _____ **Choice:** _____	_____ _____	_____ _____	_____ _____	_____ _____	_____ _____	_____ _____	**TOTAL**
Statement: _____ Choice: _____							
_____ _____							
_____ _____							
_____ _____							
_____ _____							
_____ _____							

CROSS-IMPACT MATRIX CHART: Example

IF THIS DECISION WERE MADE, **THEN THIS OUTCOME WILL OCCUR:**

Statement: Choice:	1) purpose a. profit	2) availability b. need	3) equipment b. ownership	6) disaster repair b. by user	10) service a. low rates	11) organization c. mutual	TOTAL
1) purpose a) profit		0	0	1	0	0	1
2) availability b) need	0		1	0	1	1	3
3) equipment b) ownership	0	0		1	0	1	2
6) disaster repair b) by user	1	0	1		1	1	4
10) service a) low rates	0	1	1	1		1	4
11) organization c) mutual	0	1	1	0	1		3

The analysis of the effect of one statement on the other is explained as follows:

Explanation of Sample Chart

Example 1 — Effect of purpose (1-a) on availability (2-b)

Effect = 0

If the purpose of the phone company were to make quick profits, it is unlikely that all people with great need for a phone will obtain one. In order to be profitable quickly, it will be necessary to charge high rates. Then only businesses and the rich will be able to afford a phone.

Example 2 — Effect of purpose (1-a) on equipment (3-b)

Effect = 0

If the exchange's purpose is making a profit quickly, it is unlikely that it would buy the equipment. Having to buy the equipment outright would mean having to raise a larger sum of money in the beginning. It may take many years to pay off this large investment so profits are not expected in the beginning.

Example 3 — Effect of purpose (1-a) on disaster repair (6-b)

Effect = 1

If the goal were quick profits, the company will very likely charge the cost of repairs to those who use the line. In this way the company will not need to use its own money to make the repairs.

Example 4 — Effect of availability (2-b) on customer preference (10-a)

Effect = 1

If telephones were made available to people with the greatest need, it is very likely that the rates will be low. People who need the phone are not necessarily those who can afford to pay high rates.

Example 5 — Effect of organization (11-c) on disaster repair (6-b)

Effect = 1

If the company were organized and run by the subscribers, they will probably decide to share the cost of repairs. A repair fund would be set aside so that the burden of repair cost is not borne by the few who are affected by the disaster.

(Note: These examples are just one way that the effects can be interpreted. It is possible that you may have a different interpretation. Just as there is no such thing as a crystal ball, there is no single right answer in forecasting!)

What does the Cross Impact Analysis Mean? Interpreting the Results

- Add the numbers for each row and write the sum in the *Total* column. Which of the statements received the higher score? This high number indicates that the preferred decision will bring about many of the other preferred outcomes. That is, the decision works out well with many of the others. For those that do not affect the other, it means that you cannot have both choices at the same time.

- In the *sample chart* a "quick profit" has a score of 1. This means that you cannot expect a quick profit and fulfill the other needs at the same time. This does not mean that a telephone company will not be profitable. It merely means that if you expect a *quick* profit you will not be able to provide phones for people who need them, charge low rates, etc. in the beginning. Therefore, you must decide whether or not a quick profit is more important than the other preferred goals. If not, you may need to decide on another "purpose" for the telephone company.

- This chart will serve as your guide to the next activity. By examining the different relationships, you now know what choices are preferred and beneficial.

Activity 5: Scenario: A Plan for Your Telephone Company

Student Instruction

Write a "scenario" that describes your plan for establishing a telephone company in Middletown. (This can be written individually or in small groups.)

This exercise differs a little from the earlier "scenario" writing exercises. From the Delphi Survey and the Cross Impact Matrix Analysis you have learned a great deal of information. As a result of your poll of the "experts," you now know what aspects of telephone communications are desired or preferred for your town. In the Cross Impact Analysis you have reached some conclusions concerning how the different choices affect or relate to one another. Some effects are more likely than others. If a certain decision is made, another event would most likely or not likely follow. These results, thus, provide you with more detailed knowledge for writing your scenario.

You may write your scenario in one of several different ways:

- A proposal to be presented to the Town Council for consideration.
- A newpaper or magazine advertisement to attract investors.
- A pamphlet to the townspeople to convince them of the need for a telephone communications system and to ask for their support of the system you describe. (Remember, the people have never had telephones and perhaps view the telephone as an extravagant luxury.)
- A newspaper article describing the benefits of a telephone exchange and the changes that it will bring about.

Include in the scenario the information that you have obtained so that you can more precisely describe the unique characteristics of your telephone system. The result of your Delphi Survey and Cross Impact Analysis may indicate a system quite different from any that we know today. What might be the advantages of your special system? How does it differ from our system today?

Activity 6: Trend Extrapolation: Forecasting the Rate of Growth

Readings 2 and 3 presented a capsule summary of a few of the technical changes in telephone communications. Each new development added to the usefulness of the telephone. As pointed out earlier, the first telephones were clumsy to use and one could not make calls to many people. One would expect that more people would make use of the telephone if 1) it were simple to use, 2) calls could be made to a greater number of places as well as outside one's own town, 3) the sound transmission was loud and clear, and 4) breakdowns were quickly repaired. In addition, using the telephone meant that people had to change their old ways of doing things. A businessman, for example, might still prefer to send letters by messenger because a letter appears more official. There would be no mistake in orders if they were presented in writing. Therefore, growth in telephony depended on many factors, some technological and others economic, social custom, political, etc.

In this exercise you will examine the actual growth of telephone usage by means of a forecasting method using graphs.

Trend Analysis

Overview

Trend extrapolation is one of the earliest types of forecasting techniques employed by forecasters. It is also one of the simpler and easier methods to use. The basic idea of trend extrapolation involves comparing how a certain item changes from one time to another time. This is done by graphing the item over a given time period. The way in which changes occur is called the trend. By extrapoliation we extend that trend into a future time. The extension becomes the prediction of what will take place in the future time. Trend extrapolation is most often used to study growth; that is, 1) will the growth be rapid or slow? and 2) will the growth increase or decline?

In trend extrapolation certain assumptions are made:

- **Growth progresses at a certain rate.** For example, a tree grows so many feet each year so long as weather conditions do not change drastically. It may grow more

rapidly in the beginning and more slowly later. In any case, it follows a certain pattern and that pattern is fairly regular.

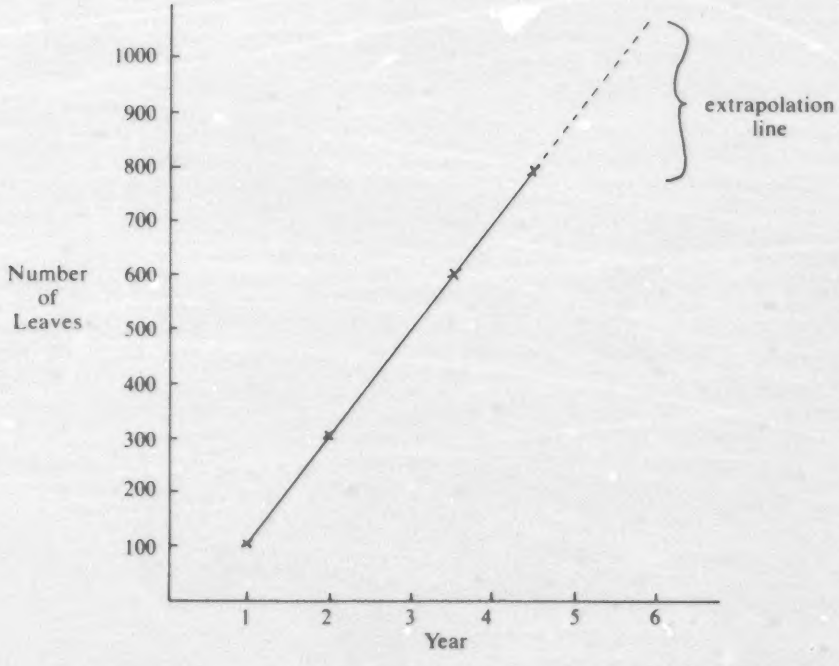
- **Growth will be continuous.** For example, if we were studying a tree's growth, we will find that it does not stop growing completely and start again from the beginning at another time.
- **The future will resemble the past.** For example, the tree's growth is similar from year to year. If it is a slow growing tree, it will continue to grow slowly. Redwoods, for instance, grow very slowly while poplars are considered to be fast growing trees. The growth pattern does not change drastically.
- **Growth has a natural limit — there is a point where increase of growth does not continue.** For example, each tree has a certain life span; it does not live forever.

Graphing and Growth Curves

Table 1

Year	Number of Leaves
1	100
2	350
3	540
4	800

Graph 1

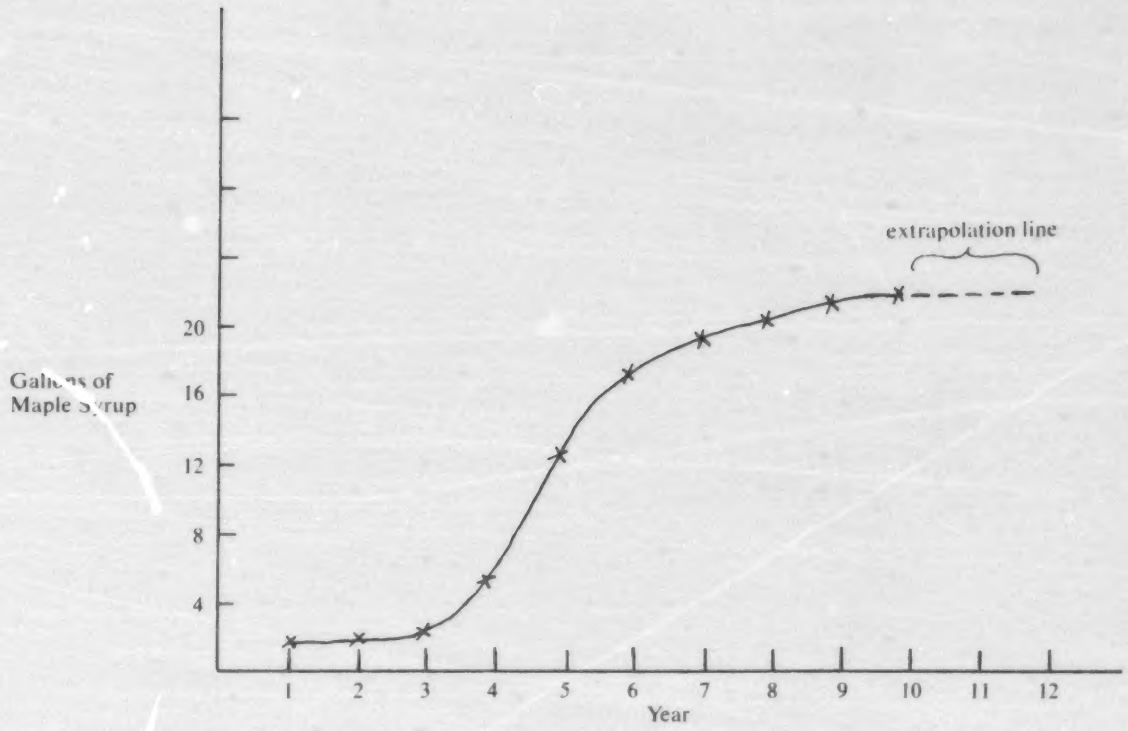


Example 1: Straight Line Curve. In Table 1 the number of leaves on a tree is given for a four-year period. This information is plotted in Graph 1. A line that will pass through most of the points or closest to all the points in this case is a straight line. This line thus represents the trend of leaf production for the tree. If one wished to predict the number of leaves the next year one would extend the line. Since the number of leaves increases very much as a straight line, one would expect the same for the following year. The line is extended using a dotted line.

Table 2

Year	Gallons of Maple Syrup
1	0
2	1
3	2
4	4
5	8
6	16
7	17
8	18

Graph 2



Example 2: S-Curve. The data from Table 2 is plotted on graph 2. In this case, the tree produces very little maple syrup in the beginning, increases its production very rapidly and then levels off. The line that best describes the points is commonly called an "S" curve (resembling the letter "S"). In "S" curve, development starts off slowly as the system becomes organized and adjusted. There is then an increasing rate of activity. Finally, a point is reached where there is little or no change. This type of curve could describe, for instance, the population growth of fish in a pond. The top of the curve would indicate the point where food and space limit the number of fish that can survive in the pond. If the pond does not expand, the number of fish will remain constant over a period of time.

Student Activity. Instruction

Number of Telephones: Graph 1. Graph 1 displays data on the number of telephones from the year 1876 to 1898. Your teacher will distribute a copy of this graph for you to complete. Imagine that you are living in 1898 and wish to forecast the number of telephones in the year 1903. Examine the information given and look for a pattern in the development. (Refer back to the section describing the different shapes of growth curves.)

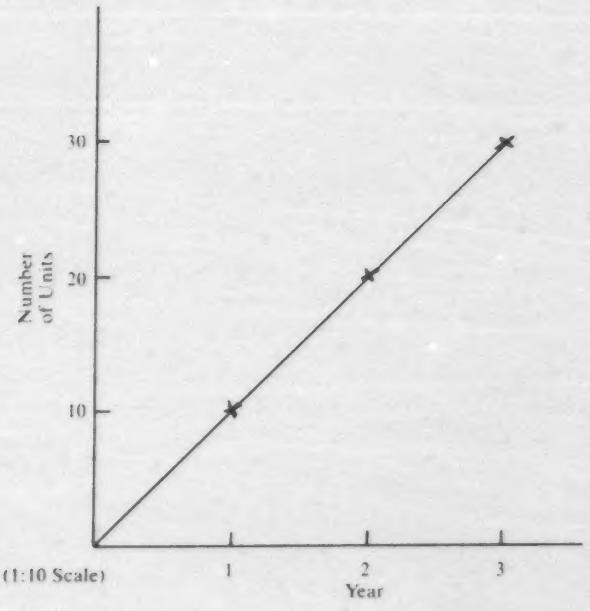
- What kind of line would best describe this set of data: Is there a line, straight or curved, that comes closest to all the points on the graph?
- Draw in a smooth line that will best fit the data; the line should be one where all points will touch or nearly touch. This is your "trend" line.
- Extend this trend line, using a dotted line (dotted lines are used to indicate projections into a future time), to the year 1903.
- How many telephones do you predict will be in use in that year?
- How close was your estimate to those of your classmates?

Number of Telephones: Graph 2. This graph displays the data for the number of telephones in use from 1896 to 1910. Again your teacher will give you a copy to complete.

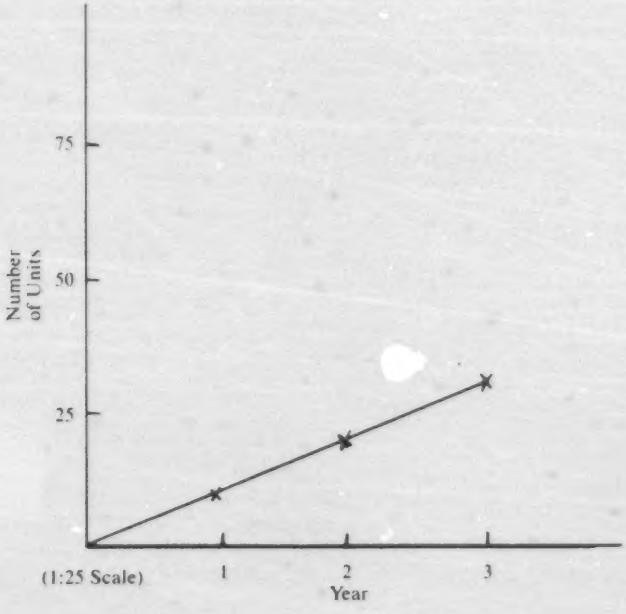
- From Graph 2 find out how many telephones were in use during the years from 1898 to 1903. Use these figures to complete Graph 1. How well does your prediction correspond to actual history? (Note: the scale used in Graph 2 is ten times greater than in Graph 1; in Graph 1 each interval between the heavy lines represents 200,000 telephones whereas in Graph 2 each interval represents 2,000,000 telephones. Therefore, if the same scale were used in Graph 2 as in Graph 1 the line would climb more steeply but at the same time one would need a much longer sheet of paper. In either case, the actual growth rates or change is the same.

- *Example of changing the scale* Below are two graphs. They differ in the scale used for the Y axis. The line in Example 1 is steeper and the increase appears greater. However, if you compare the data points on the lines of Example 1 and Example 2, you will find that they are the same.

Example 1



Example 2



- Draw in the trend line for Graph 2. Again, using dotted lines extend the line to the year 1920. How many telephones do you predict will be in use in 1920? Make a prediction for 1930.
- Is there a difference in the shape of the trend lines in Graph 1 and Graph 2? What do you think contributes to this difference? Why did the number of telephones increase more slowly between the years 1876 and 1896?
- How well does your prediction compare with the actual numbers?

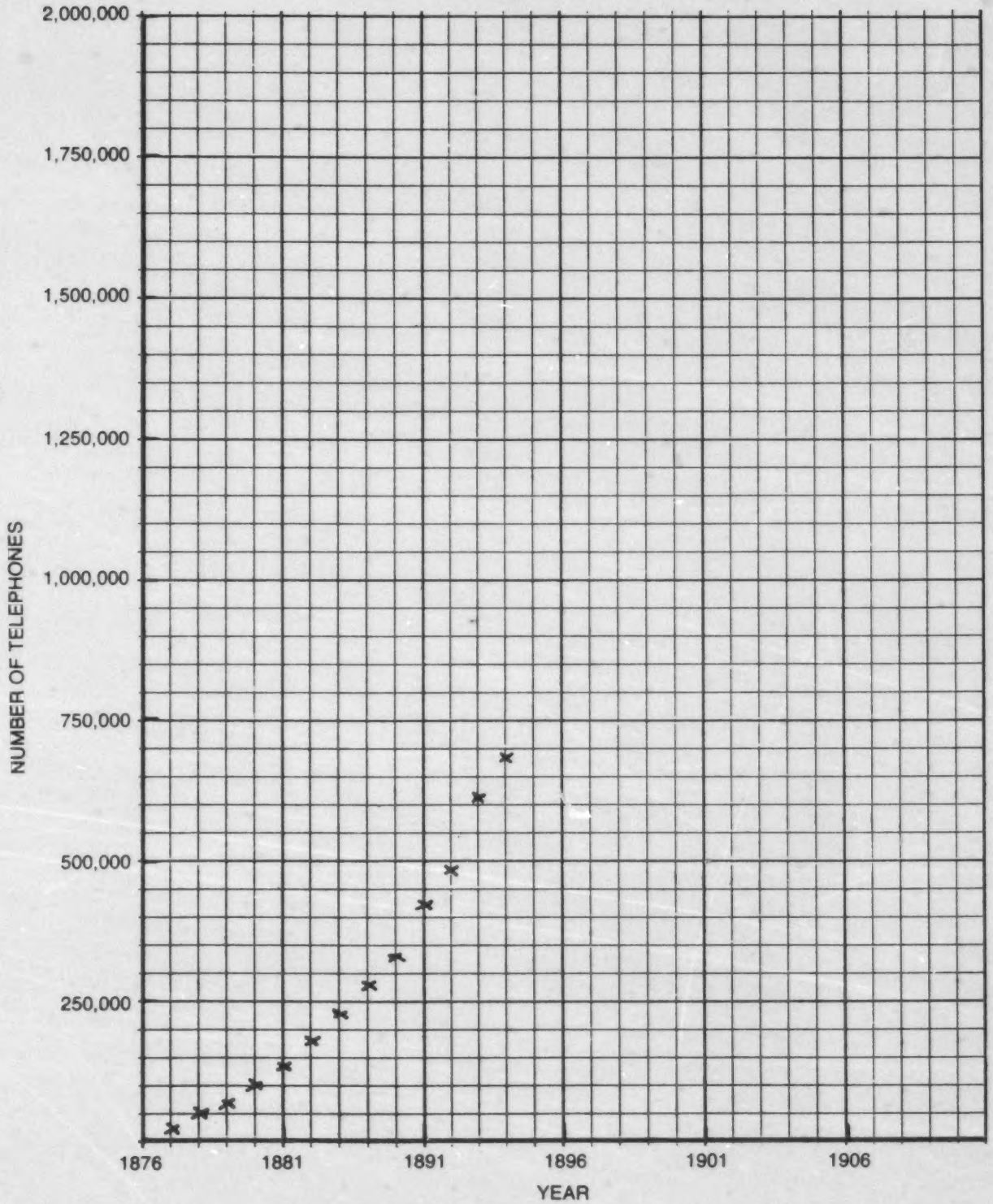
Miles of Wire: Graph 3. This graph plots the miles of telephone wire from the years 1880 to 1900. Your teacher will distribute a copy for you to complete.

- Draw in the trend line for this graph.
- What do you predict for 1902? 1907?
- Compare the increasing trend in the miles of wire with the increase in number of telephones.
- What are the similarities in the growth rate? Any differences? If you think there is a difference, what do you think makes the difference?

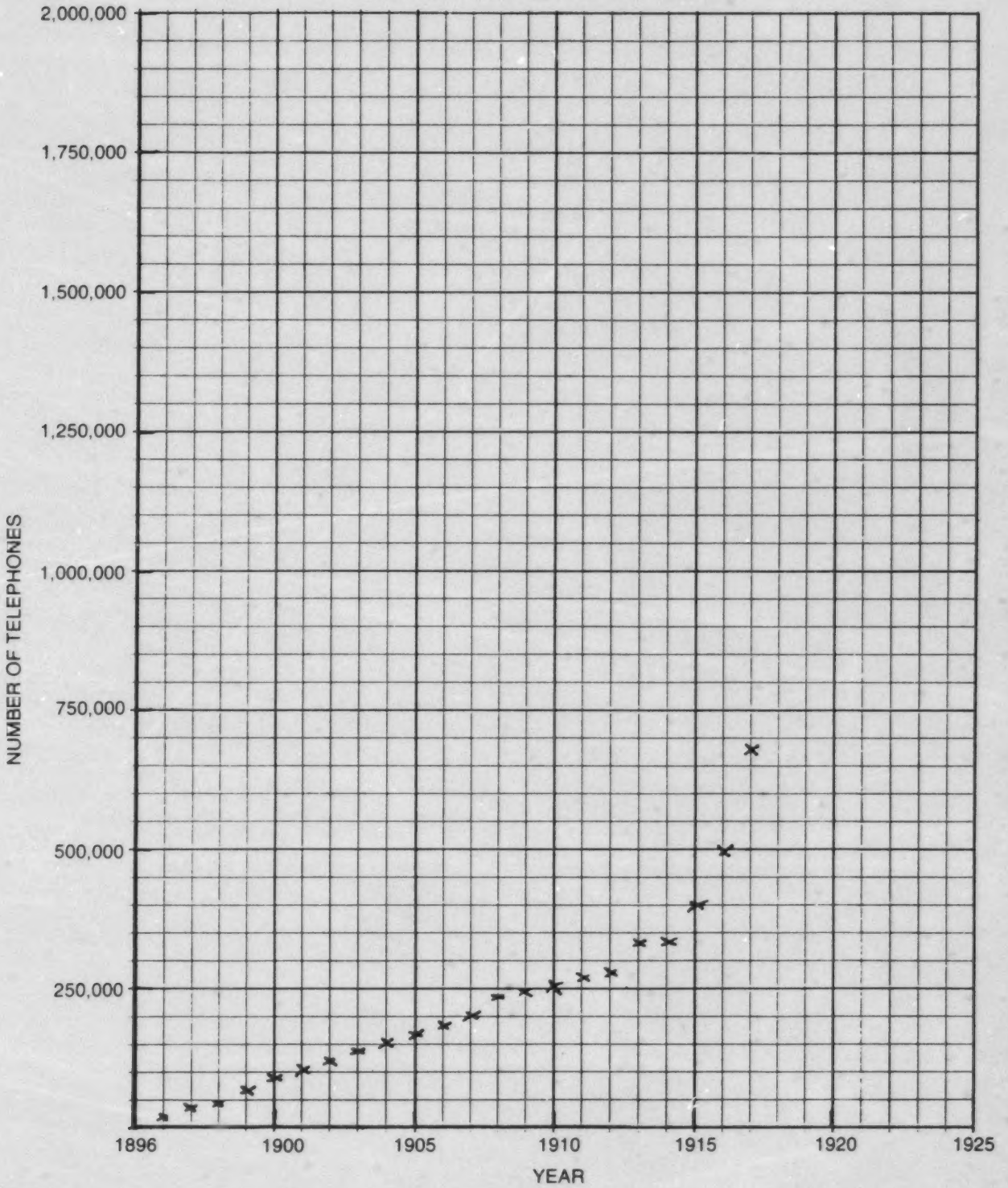
Number of Telephones for Every 1,000 People: Graph 4. This graph shows the number of telephones for every 1,000 people in the U.S. in the years 1896 to 1910. Your teacher will distribute a copy for you to complete.

- What trend do you predict for the increase in the number of people who have telephones? Draw in the trend line.
- In what year do you predict that every household will have a telephone? (Assume that there are four persons in a household.)
- Will the number of telephones in this country continue to increase. Will the growth in the number of telephones level off? (That is, will the increase always be as rapid?)
- What factors will influence the increase in the number of telephones?
- The U.S. today has a population of about 225 million people. How many telephones do you think we now have?
- What predictions can you make about future uses of the telephone?

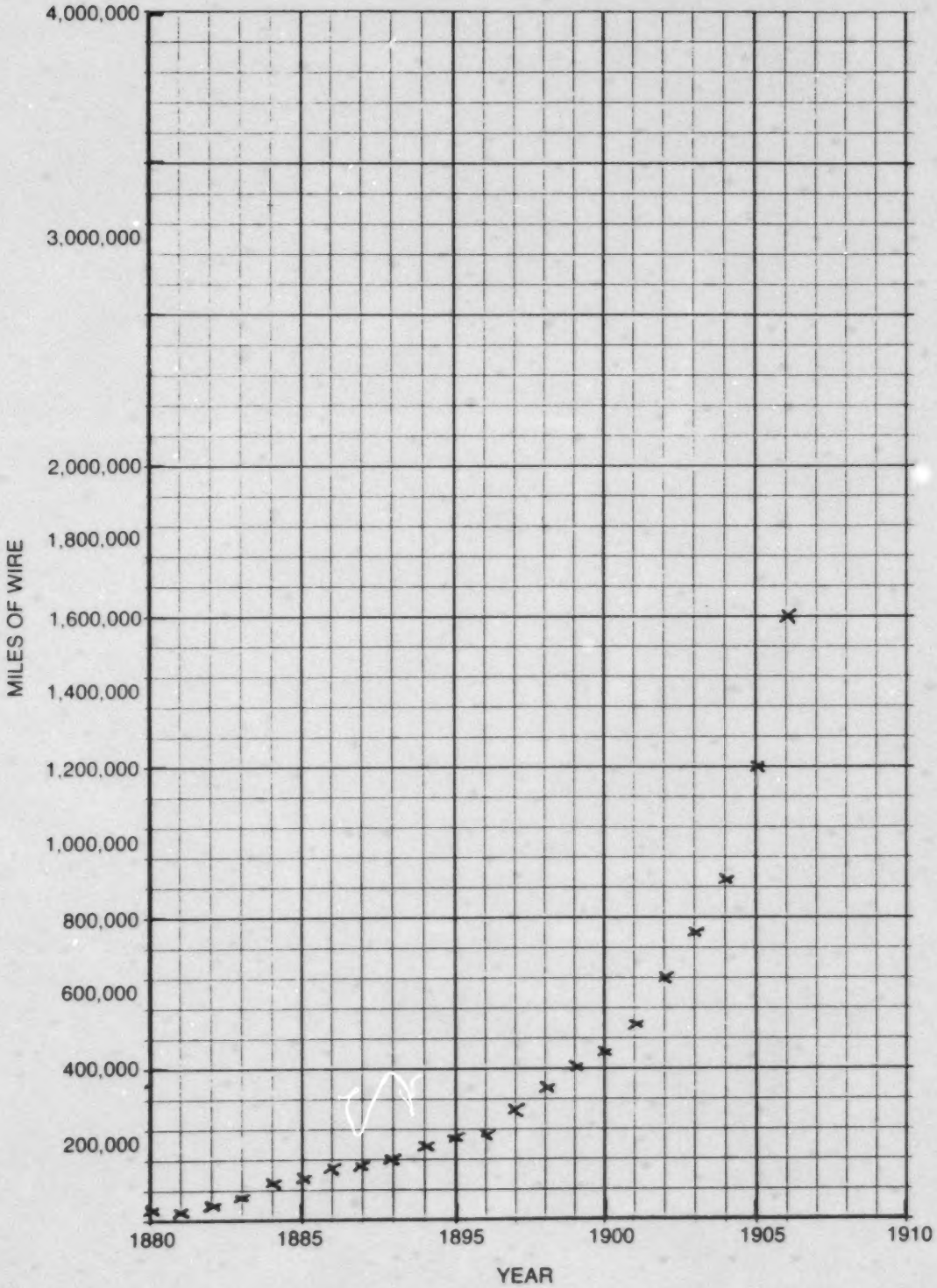
GRAPH 1: Telephones From 1876 to 1898



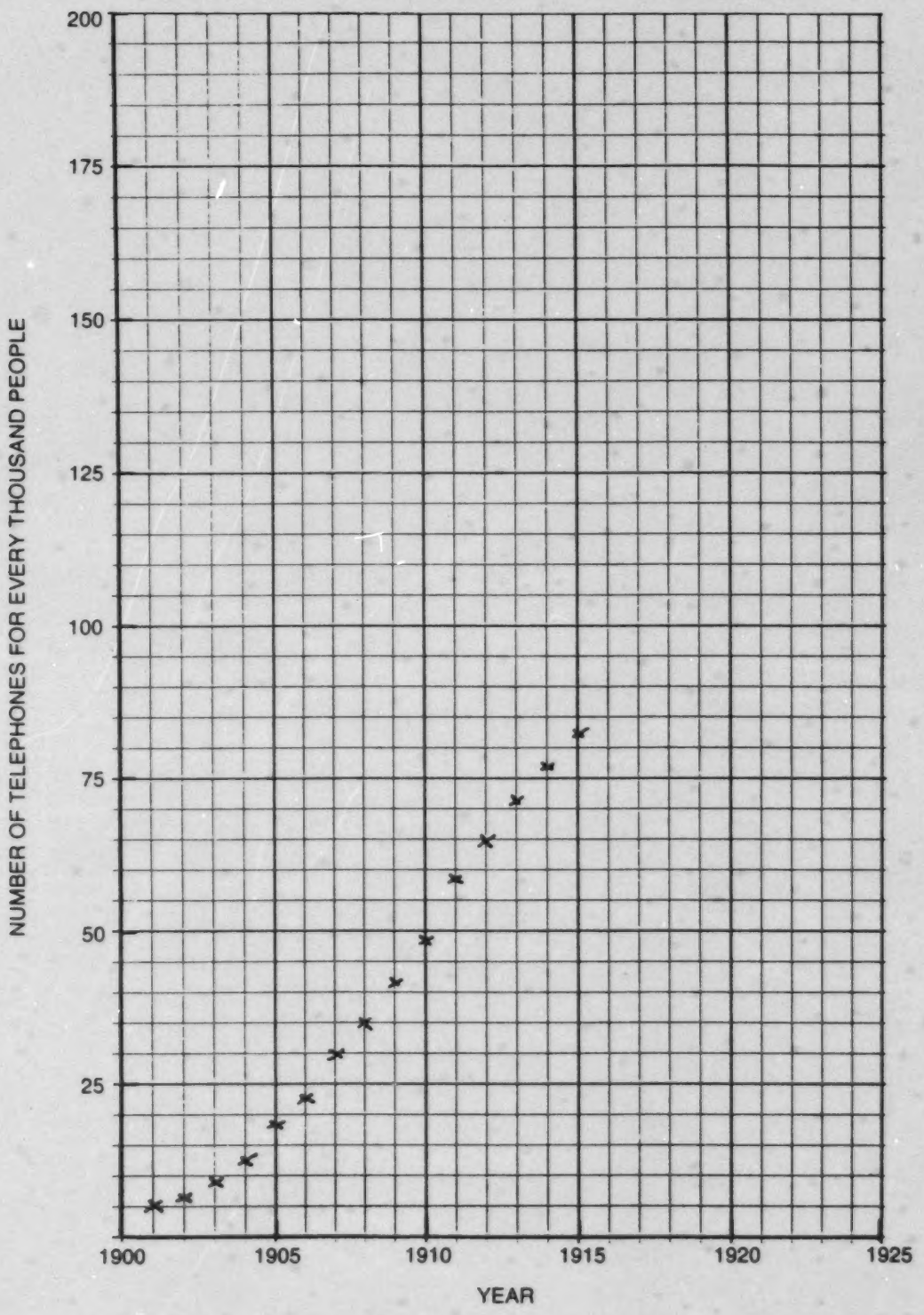
GRAPH 2: Telephones From 1876 to 1908



GRAPH 3: Miles of Wire 1880-1900



GRAPH 4: Number of Telephones for every 1,000 Persons, 1896-1910



Activity 7: Who Will Get a Telephone? A Role Playing Exercise

At the turn of the century, telephones were used by very few people. They were usually found in businesses and homes of the rich. Having to pay a yearly flat rate prevented the average person from installing a telephone.

Consult Graph 4. In the year 1900 how many people in 1,000 had telephones? In 1910? Do you think that if people were charged just for the number of calls made, more people would install telephones? How is one charged for telephone service today?

Instructions for Role Playing Exercise

In this exercise you will decide who should receive a telephone. The year is 1910. In a rural and an urban community there is one new telephone available. A decision must be made as to who will get that telephone. Eleven students in the class will take the role of a telephone applicant. Use the roles given in Exercise I — Rural and Urban Community Charts (e.g., farmer, scientist, housewife, etc.). The remaining members of the class will serve as the panel of judges. They will cast their votes for the person with the greatest need for a telephone.

Instructions to the Eleven Telephone Applicants

Take the role of the person you have selected or have been assigned. From the viewpoint of this person:

- Make a list of the *best reasons* to support your need to have a telephone.
- Using your list of reasons, develop a five minute presentation to the panel of judges who will make the final decision as to who will receive the telephone service. (In making your argument consider how your having the telephone will benefit others in your community. What changes in your life and the lives of others will result from your having a telephone?)

Instruction to Panel of Judges

Your task will be to decide from among the eleven applicants the person who should receive the telephone. In this hypothetical situation, the production of telephones has suddenly been halted and for these eleven people there is but one telephone available.[1] In making your decision consider the following questions.

- Who will have the greatest need to communicate with other people?
- How important is rapid communication to that person?
- How will that person's telephone calls affect the lives of others?
- Will that person be able to afford the telephone service? If cost were not a factor, would that change your vote?
- How might the telephone change his/her business and social activities? What are the benefits of those changes?

At the end of each presentation, each judge is allowed to ask the applicant one question.

You will be given a copy of the following table to complete during the presentation. (Do not write in the booklet.) The completed table should help you in deciding who should receive the telephone.

When all the presentations have been made, vote for the one person most deserving of the telephone by writing his/her title on a slip of paper. Each judge will have one vote. The person who receives the greatest number of votes will receive the telephone.

If no one candidate receives more votes than the others, the panel of judges will call a ten-minute conference to discuss the presentations and try to reach a consensus. A second vote will then be taken.

[1] Although this situation may seem very farfetched to you living in the U.S., it is a very real and important problem facing many countries. In France, for example, a telephone is a hard to obtain status symbol. The waiting line for a telephone can be as long as several years. There are stories of people who are willing to take an apartment without a toilet, sink or stove but with a telephone!

The French telephone system, run by the government, has been unable to keep up with the demand or provide reliable service. Only about 40% of homes have telephones. There are about 16 telephone lines for every 100 people. (In the U.S. there are 38 lines per 100 people). As a result, the cost of installation is high; there is a six minute limit on calls made on public phones; a caller during certain hours may have to wait up to 40 minutes just to obtain a dial tone.

However, there are ways to get around the telephone problem. If one wanted to get a message to someone without a telephone, one could telephone the message to the post office which then delivers the message within two hours.

How do you think this system affects the people living in France?

Activity 7: Who Will Get a Telephone?

TABLE TO AID IN DECISION MAKING

Title	Number of Calls Made	Personal Need of Phone	Business Need of Phone	Will Calls Benefit Others	Total Score
1. Vegetable Warehouser					
2. Scientist					
3. Fire Chief					
4. Housewife					
5. Worker					
6. Farmer					
7. Newspaper Editor					
8. Butcher					
9. Sheriff					
10. Student					
11. Tailor's Apprentice					

Under each of the headings, determine the importance of the telephone to each of the persons listed. A one (1) to five (5) scoring scale will be used for each category.

1 = least (number, need, benefit)
2 = lesser (number, need, benefit)
3 = moderate (number, need, benefit)
4 = great (number, need, benefit)
5 = greatest (number, need, benefit)

Each person shall receive a score from one (1) to five (5) for each of the four categories. When all the role presentations have been made and the table has been completed, add across the table to obtain a total score for each of the eleven persons. The higher scores would indicate the persons who have most need of a telephone.

Part II.
The Computer

Introduction

Now that you have examined the early history of the telephone and its impact on our society, we will take a look at a more recent technology. This technology, the computer, promises to have a dramatic effect on our lives and the way we communicate. In our study of the electronic computer, we will use the same futures forecasting techniques you have already learned. You will now develop your vision of what future communications should be like. You will try to answer such questions as: What kinds of information and services will you need in the future that computers could provide? What threats to personal freedom and privacy do computers pose? Are you willing to surrender some personal freedom? How many people might be able to afford their own computer?

You will probably be surprised to learn about the many computers already in use and about the kinds of things computers can do. For instance, you probably know that computers make up and send out many of the bills which your parents receive. But did you know that computer systems are in operation which make money and even credit cards obsolete? A paycheck can be credited to an account number in a central computer and monthly bills or purchases at local stores can be charged to the account over the telephone. Money is never exchanged.

Computers are also being used now to control manufacturing processes and the operation of appliances in the home. Lights, heat, stoves and even music systems are turned on and off automatically from a central home computer. Some computers can now talk, recognize your voice, play games with you and write music. A new hobby called personal computing is growing rapidly. Several companies are making and selling computers and components priced below the cost of a television set. Computer hobbyists are learning to build systems, write programs to operate them and modify them to do new and interesting things.

These computer applications already exist. Imagine the possibilities for the future! Home computers may one day be as common as television sets. You may be able to push a few buttons to contact a computer and have music by your favorite group piped into your home from a central tape library. In the same manner, you could have your favorite films or television shows sent into your home. You will no longer be limited to the television shows offered by the major networks; your choice would be almost infinite.

The workplace for many office workers is becoming a different kind of place. Filing cabinets and various kinds of office equipment are disappearing as information is transferred to computer tape. Computer terminals are replacing office calculators, dictating equipment, and typewriters. There may even come a time when people in certain jobs may not have to report to their office each day. Accountants, designers, mathematicians and engineers who have a computer terminal installed in their home can now stay there and work.

Schools could be changed drastically or even disappear. Computer access to libraries and other sources of information around the world could produce a new kind of education. One could use the computer to "talk" to students and teachers in other countries and exchange ideas. Homework could be done on the computer and turned in to a teacher using the computer. Rather than report to school, students could learn from their computers at home.

These future possibilities may seem exciting and obviously beneficial. However, there are some problems which must be explored. Decisions must be made about what kinds of information should be stored in computers and about who should have access to that information. Who makes these decisions? Who will control the system? Will people who do not have computers be at a severe disadvantage?

These are the kinds of questions we will explore in this section of *Future Scenarios in Communications*.

Reading 4: The History of the Computer

This brief history of the modern electronic computer will focus on the period from 1890 to the present. The year 1890 was selected as a starting point because the United States census taken in that year was done using an electric machine with many features of a modern computer. The electric tabulating machine was invented just for the occasion by Herman Hollerith. It used electric circuits to process information contained on punch cards.

We will trace three lines of machine development — calculators, statistical machines and logic machines. As we will see, these lines of development united into a single technology to produce the electronic computer, combining all three types of devices.

The ideas for modern computers, however, goes back to the early 1800's. Charles Babbage had the vision to design a general purpose problem solving machine in 1833. This Analytical Engine could solve mathematical problems from preprogrammed instructions. The design included a memory component, called the "store," and a processing unit, called the "mill." The Engine was controlled by input in the form of punch cards. These components are all features of the modern computer.

Is the computer a substitute for thinking?

Calculating Machines

By 1890, mechanical calculating machines were in limited use in the United States. Adding machines were the most popular and dependable. However, devices used for multiplication and division were slow and complicated. Complex calculations were usually carried out with logarithmic tables. The first multiplication machine which was successful was designed by Otto Steiger. The "Millionaire," as it was known, could multiply or divide. It was still being used in 1935.

Between 1890 and 1900 the "Millionaire" was joined by two American calculators — the Comptometer and the Burroughs Adding and Listing Machine. These calculators were used to solve accounting problems in the business world and for calculations in astronomy.

The advent of World War I brought many new uses for calculators. The effort to raise an army and to improve artillery produced vast quantities of data to be analyzed. As a result, new government departments were established and given rooms filled with calculating and tabulating equipment.

After the war, scientists began working on problems which required more complex calculations. Vannevar Bush of M.I.T. and others developed machines with new capabilities. The first of Bush's two major inventions was the product integraph which allowed scientists to combine equations in graph form. His second invention was the differential analyzer. It was the first automatic mechanical computer which could solve many different kinds of problems.

In 1936, a German engineer, Konrad Zuse, began designing and building a series of calculators. They used such basic computer concepts as binary arithmetic, the floating decimal point and program control by punched tape. Other researchers, including Claude Shannon and George Stibitz in the U.S., were designing the first electrical calculators. Both men used relays and cross-bar switches developed for use in the telephone industry.

The end result of this line of development was achieved in 1944 at Harvard University when the Automatic Sequence Controlled Calculator (A.S.C.C.) was completed. This machine took six years to build. It was automatic and could process numerical data using punch cards, tapes, or dials.

Statistical Machines

A statistical machine is a device used to examine large amounts of data for trends. Before the invention of the statistical tabulating machine by Hollerith, compiling information was either carried out by hand or with adding machines. Life insurance companies, banks and manufacturing firms had large staffs of clerks who recorded and analyzed data.

The U.S. Census Office was in need of a fast, accurate method to gather the 1890 census. As late as 1887, the Bureau was still analyzing the data from the 1880 census. A contest was held to select an efficient data processing system. Herman Hollerith won the contest with his electric tabulator.

The tabulator was designed to perform a very simple function. It kept a running total of answers for each question on the census form. At the end of the tabulation process, the Census Bureau knew a great deal about the American population. It could tell the total population size; the number of men, women and children in the country; where people lived; and so on. This tabulation was made possible through the use of punch cards. The information on each census form was summarized on one card.

In the early 1900's, large industries began to apply the Hollerith tabulating equipment and other card sort systems to their own unique problems. Railroads used tabulating equipment to keep track of large numbers of packages. Public utilities installed tabulators to simplify billing. Insurance companies also used tabulators for billing and for predicting life expectancies. As the machinery became more widespread, new applications were discovered. The ease and speed of recording and tabulating data made it possible to keep accurate records of shipments, materials, costs, and sales. This information made it possible to control production and distribution and to reduce product cost. The efficiency which resulted was necessary for the introduction of assembly lines and mass production.

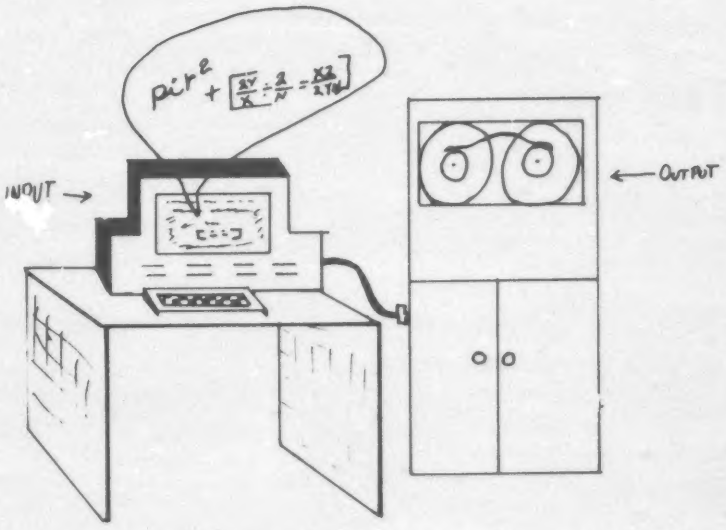
Through the 1920's and 1930's, statistical machinery was applied to a great variety of complex problems. Thomas J. Watson, Sr., as president of IBM, played a key role in this development. At his direction, IBM engineers adapted punch card machines for new uses. IBM salesmen introduced the devices to many potential users in business, government, science and education.

The "world's biggest bookkeeping job" was undertaken when President Franklin D. Roosevelt signed the Social Security Act into law in 1945. As a result, the government was required to keep employment information on 26 million people. This task would have been impossible without the card punching and sorting equipment invented by Herman Hollerith.

Logic Machines

The electronic computer would never have come into being without the development of the concept of automatic control. This idea came about with the invention of logical automata. These were machines with gears and levers used to solve problems in logic. By 1890, automata had not yet appeared although a number of individuals had designed logic machines. From these devices came a variety of devices with internal control. These devices called servomechanisms were first used in industry to replace human operators who watched gauges and dials in order to monitor and adjust temperature and flow or pressure of materials. Servomechanisms operated on the basis of feedback. Sensing devices were used to detect changes in temperature, pressure, light, or electrical output. A change in the measurement became the feedback information that set off the machine to make the adjustments.

An important goal-seeking machine using internal feedback mechanisms was developed in 1942 during World War II. The M-9 gun director brought together automatic calculation, using feedback, with electronically controlled servo-mechanisms. The M-9 was used in anti-aircraft batteries in London to defend against



Computer solves a difficult problem

German V-1 rockets. The M-9 was exceptionally accurate. In some instances it hit 95% of the V-1 rockets at which it fired.

The Modern Computer

With the invention of the M-9 and its use of electron tubes, the stage was set for the merging of all three lines of machine development — calculators, statistical machines and automata. New techniques for calculation were combined with the automatic control of gun directors and with statistical data handling in punch card accounting machines.

The first general-purpose computer was the Electronic Numerical Integrator and Computer or ENIAC for short. ENIAC was developed by J. Presper Eckert, Jr. and John W. Mauchly. It was used to generate ballistic tables. It could calculate the flight path of a single projectile in about thirty seconds. A skilled person using a desk calculator could compute the same trajectory in about twenty hours. Although ENIAC was not finished until 1946, after the war had ended, it was used to solve scientific problems until the early 1950's.

One final basic concept was added to the ENIAC type of computer to produce the kinds of computers in use today. This was an idea developed by John von Neumann, working at the Institute for Advanced Study in Princeton, New Jersey. He designed a computer called EDVAC which had its own "stored program." The program was a set of instructions controlling the operation of the computer. It was stored in the computer's memory bank in a number code and treated as other data. For the first time, choices of program procedure could be made by the machine. The instructions could be changed on the computer as required. In his design for EDVAC, Dr. Neumann had provided a blueprint for the modern computer.

During the five-year period ending in 1955, the computer took its first steps toward becoming a commercial product. In 1951, Remington Rand installed its first production line computer, UNIVAC I, in the Bureau of the Census. Three years later the first commercial computer, also a UNIVAC I, was delivered. These early computers with acronyms like EDVAC, EDSAV, MADAM and MANIAC used vacuum tubes, cathode-ray tubes, and magnetic drums.

By 1960, ferrite (iron) cones had replaced magnetic drums for memories, and transistors had replaced vacuum tubes for logic and arithmetic. The number of computers had increased to 6,000 by the end of the decade. This increase was due in large part to the development of computer languages — special programs that simplify computer programming. Total computers — as measured by the total number of additions that all computers in the U.S. could perform — increased 20 times between 1955 and 1960.

In the following decade, computers came into general use in scientific and business operations. By 1970 computers were being used by industries to handle orders, keep track of supplies, and for production control. Airlines were using computers to control seat reservations and newspapers were using them to set copy. Over eighty major manufacturers were making computers. About one million people were directly employed by computer firms. Since 1970 vast networks of computer systems have been developed in the United States and around the world.

Activity 8: Scenario — A Computer in Your Life

Introduction — The Computer Age Miracle

It is smaller than a dime. It is made from one of earth's most abundant substances, sand. It can do more calculating than a 1965 model room size computer. It can be mass produced for a few cents. What is it?

ANSWER: microprocessor, a computer on a chip

The "chip" has revolutionized the computer world! The complex circuitry of wires, switches, vacuum tubes are now compacted into a tiny chip using electronic circuitry. Through a maze of "off" and "on" electronic signals, information can be stored, analyzed and used to perform tasks. The tiny chip, consisting of hundreds of thousands of integrated circuits, can easily outperform the 1956 vintage ENIAC. That machine was larger than a moving van, cost millions of dollars, and contained 18,000 vacuum tubes and 7,500 relays and switches. Smaller in size, lower in cost and containing more functions, the chip has opened a new world of possibilities. It provides the logic or circuits for carrying out computer operations. Already, we find microcomputers in all areas of our daily lives: digital watches, hand calculators, TV games, microwave oven controls, automobile computers to detect engine problems and calculate gas and mileage, and many more. For a few hundred dollars, people can own their own home computer. While watches or TV games contain computers programmed to do certain tasks, home computer systems will permit one to write one's own program instructions to control appliances and keep track of household information such as bills, tax records, lists of things to do, etc.

The following is a scenario which describes a household operated by a computer. It appears in the February 20, 1978 issue of TIME Magazine.

It is 7:30 a.m. As the alarm clock burrs, the bedroom curtains swing silently apart, the Venetian blinds snap up the thermostat boosts the heat up to a cozy 70°. The percolator in the kitchen starts burbling; the back door opens to let out the dog. The TV set blinks on with the day's first newscast: not your Today show humph-humph, but a selective rundown (ordered up the night before) of all the latest worldwide events affecting the economy – legislative, political, monetary. After the news on TV comes the morning mail, from correspondents who have dictated their messages into the computer network. The latter-day Aladdin, still snugly abed, then presses a button on a bedside box and issues a string of business and personal memos, which appear instantly on the genie screen. After his shower, which has turned itself on at exactly the right temperature at the right minute, Mr. A is alerted by a buzzer and a blue light on the screen. His boss, the company president, is on his way to the office. A. dresses and saunters out to the car. The engine, of course, is running . . .

After her husband has kissed her goodbye, Alice A. concentrates on the screen for a read-out of comparative prices at the local merchants' and markets. Following eyeball-to-eyeball consultations with the butcher and the baker and the grocer on the tube, she hits a button to commandeer supplies for tonight's dinner party. Pressing a couple of keys on the kitchen terminal, she orders from the memory bank her favorite recipes for oysters Rockefeller, boeuf a la bourguignonne and chocolate souffle, tells the machine to compute the ingredients for six servings, and directs the ovens to reach the correct temperature for each dish according to the recipe, starting at 7:15 p.m. Alice then joins a televised discussion of Byzantine art (which she has studied by computer). Later she wanders into the computer room where Al ("Laddy") Jr. has just learned from his headset that his drill in Latin verb conjugation was "groovy."

If you owned a home computer, what type of tasks will you have it do? Or, if you already have a computer, what does it do for you now and what things might you like it to do in the future?

Student Activity

Write a scenario describing how a computer might be used in your home. Consider the following questions:

- Many household devices that run on electricity may be computer controlled. Which ones might you link to the computer to help you save work or time?
- Computers store information and at a later time can be instructed to analyze or organize that information. What types of information might you put in your computer and how might you use it? Write birthday cards? Make appointments? Determine how you should use your earnings or allowance?
- What household items might you no longer need? (Reminder: anything that can be typed on a typewriter can be stored in the computer.)
- If the computer gives you more free time, what would you do with that time?
- Will the computer allow you to do things at home that normally require you to travel elsewhere?
- Are there things you like to do for yourself and will not want the computer to take over?
- Computers can be linked with other computers that store different types of information. What kinds of information might you want a computer to provide?
- What types of entertainment would you like your computer to provide? For example, video cassette recorders are computerized. How might it or does it change the way you watch TV? If someday it is tied to film or TV libraries through the world, how will your entertainment opportunities be expanded?
- Can you think of ways that a computer might help you in your school work?
- If your computer were linked to your friend's computer what type of things can you do together?

Reading 5: Computers + Communications = "Compunications"

We have talked about the development of the computer mainly from the viewpoint of its ability to store information, control devices and solve math problems quickly. Yet, another line of development is taking place, a system of interconnections. While telephony is a system of lines connecting one telephone to another, the computer is creating a new type of interconnecting structure — a network of information sources. The computer, telecommunications and teleprocessing are merging to create what Anthony Oettinger has called "compunications." In this capacity, the computer serves as a switching device to call for information stored in other computers and to transmit information, messages or pictures to other computers.

Through a system of interconnections with telephone lines, communication satellites, television cables, microwaves and/or optical fibers one can obtain a multitude of information and entertainment by pushing the right buttons. Data banks that store books, newspapers, monies, research studies, business reports, statistics, etc. can all be available. Unlike television which is a one-way receiving system, "compunications" offers two-way communications. One can interact with another or many other computers, sending data or letters or holding conferences. Take, for example, the sending of letters. One could type or hand write the message, push a few buttons and in seconds or minutes it arrives at its destination. You need not worry that it will get lost on the way or that the recipient is not home. The message will remain in the computer memory until read.

Or, one can send a request to a central computer library for articles on the subject of baseball bats. That computer will search through its files and in a matter of seconds begin to send the articles. The receiver can read the articles off a screen, have them printed on paper or store them in the computer's memory.

The basic equipment required includes a central computer, a memory unit, a TV-like screen, a teleprinter, a typewriter-like keyboard and connections with outside networks. The means of connecting to outside networks is perhaps the most crucial factor. However, as with the development of the telephone, the major questions are now, "what kind of connecting

lines?" and "who will install the connecting lines?" While telephone lines currently connect businesses, research companies and libraries to data sources, the speed of transmitting the information in digital form is quite slow compared with the speeds that computers can operate. It takes several seconds to send a printed page and pictures take several minutes. To send an entire book in this manner may be quite costly especially if one uses long distance telephone lines. For businesses it may not be expensive if the information brings about a million dollar order. But for individuals the cost is not practical. Other ways of connecting computer systems are being explored and developed.

The use of optical fibers (made of very thin glass) and laser beams offers much faster transmission. However, this would require changing our existing telephone cables. The cost would be staggering, running over billions of dollars, not to mention the need to dig up every city street to install the lines! Cable TV offers another means for transmitting large quantities of information. But unlike telephone lines, cable TV is not available everywhere. A cable TV company will only bring lines into a community if there are enough subscribers.

Transmitting by communications satellites is another attractive possibility. They transmit over a wider band width. Hence, it is possible to transmit as fast as computers currently run, processing over a million instructions per second. Satellite messages can be sent over a large area and can reach even the most remote areas. Antennas located at different places can receive at the same time. Satellites are not free from problems. They can fall out of orbit. Heavy rainfall interferes with reception. It may be necessary to have back-up satellites as well as back-up receiving earth stations.

A great deal of information, printed materials (magazines, newspapers and books), various types of entertainment, etc. can be stored in computers. In fact, the amount of knowledge and information has been accumulating so fast that our libraries are bulging at the seams. Shelves of books can be stored in the form of computer tapes or disks and take little room. The library of the future will be stored in computer memories! Will you be reading books from your own home computer terminal or will you go to a terminal located at a computer facility? Will you order a copy of a computer printout of the book from a central computer? This will depend upon the types of connecting networks that are established. If home computers become as common as the telephone, if the connections make it possible for you to obtain many types of information and if the cost is low, your personal computer terminal could be your library, your entertainment center, your source of news, your research facility, your shopping center, your office . . . The possibilities are endless!

Activity 9: What Are Your Computer Forecasts: A Delphi Survey

In this exercise you will use the Delphi Survey for a different purpose than you did in Part I. As you recall, in the previous Delphi activity you were asked to take the role of an "expert" businessperson and make decisions about how to best start a telephone company. In this activity you are asked your opinions about advances in computers and the changes that will occur. As you carry out this activity, you will have the opportunity to express your own feelings about the computer.

Instructions

You will conduct two rounds of the survey by completing the following questionnaire twice. Your teacher will distribute a copy of the form, *What Are Your Future Forecasts?* The form lists several types of future advances in the computer and changes that might occur.

On the form you will indicate

- whether you think the advances and changes are desirable,
- when you think they will occur,
- what are the effects of the advances and changes, and
- why you came to these conclusions.

If you need more space to explain your conclusions, use the back of the form.

When everyone in the class has completed the survey, the forms will be collected. A moderator or small committee will total the results and summarize the comments. The results, presented on a survey form, will be posted for the entire class to examine. After reviewing the results, the entire class will fill our a second survey form.

Delphi Round One

- Each student will receive one copy of the survey form and individually answer the questions. It is important that you do not discuss your responses with anyone else. As mentioned before, one of the major assets of the

Delphi Survey is confidentiality. This allows members of the Delphi panel to freely express their opinion without being influenced by others.

- On the left hand column of the form are a list of advances and changes. Take each one in turn and decide whether you think it is desirable. There are four choices (VERY DESIRABLE, DESIRABLE, NEUTRAL, and NOT DESIRABLE). Mark (X) your choice in the proper box. Then indicate when you think it will occur:

  Between 1980 and 1990?
  Between 1990 and 2000?
  Between 2000 and 2010?
  Beyond 2010?

Again, mark (X) the proper box.

- On the next column, list some effects you think will take place.
- On the last column, explain why you came to that conclusion. That is, what information or events helped you make your decision? (Use the back of the form if you need more space for your answer.)

Delphi Round Two

- Review the results of Round One presented on the summary survey form. How did your responses compare to the responses of the other panel members.
  - Where was there greatest similarity? Differences?
  - Do you agree or disagree with the explanations given? Why or why not?
  - Do you think that the forecasts can be supported by the evidence?
  - Where was there greatest agreement among the panel members? Greatest disagreement?
- Your teacher will distribute a second copy of the survey form. Complete the form in the same way as you did on the first round. This time, however, you know the opinions of the rest of the panel. What do you think about the majority opinion? Are there any changes you wish to make? Again, explain how you made your decision in the space provided. Be sure to indicate the facts that support your decision.
- A moderator or committee will again summarize the results and present the findings to the rest of the class.

Discussion of the Results

- The results of the two rounds are put on the blackboard or copies on a transparency to project on a screen. In this way the class can easily compare the survey responses.
- During the class discussion, consider some of the following questions:
  - Are the results of the two rounds similar or different?
  - Were there many changes made in the second round?
  - On which items was there greatest agreement among the panel of experts? Greatest disagreement? Can you explain the reasons for the agreement or disagreement?
  - What does the panel like most about computers? Least?
  - In what ways will the computer change the way we live?

Delphi Survey 2: What Are Your Computer Forecasts?

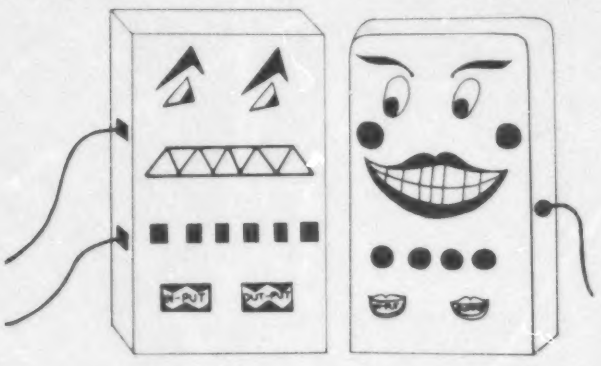
	In Your Opinion How Desirable is This?				When Do You Think This Will Occur?						
	very desirable	desirable	neutral	not desirable	1980 - 1990	1990 - 2000	2000 - 2100	beyond 2100	never	**What Are Some of the Effects?**	**Explain Why You Came to This Conclusion**
ADVANCES IN COMPUTERS											
1. Computers will understand human speech & respond to spoken instructions.											
2. Computers will learn from experience & correct their own mistakes.											
3. Computers will perform thinking and planning tasks.											
4. Computers will operate motor vehicles, trains, subways & ships without need of human operators.											
FUTURE CHANGES											
1. Every household will have a computer.											
2. Nearly everyone will know how to program a computer.											
3. Most courses in schools will be taught by computers.											
4. We will use computers to decide where to live, who to marry, what job to take, how to spend money.											
5. If one wants information about another person, one can obtain it from a computer data bank.											
6. With computerized banking & exchange of money electronically, cash will not be needed.											
7. A majority of people will spend most of the day at home.											

Reading 6: The Computer: Friend or Foe?

Some people see the computer as one of the great human achievements of all time. Do you feel this way? The enormous capabilities of computers offers promises of doing human chores more rapidly, efficiently and reliably. With the aid of computers we can accomplish what we once thought was impossible. And, we can be freed from the drudgery of many routine chores or dangerous jobs. In addition, we can have access to all recorded knowledge and unlimited choices of entertainment by simply pushing buttons on our home computer. From remembering addresses to controlling space travel, our new found powers appear endless. We have placed great hope on the "computer age" to revolutionize education, medical care, the workplace, travel, business, and so on.

However, the computer has also created great suspicion and fear. Some people see the computer as a strange, menacing, demon force. Hal, the computer robot in *2001: A Space Odyssey* is such an example, turning against its masters and methodically murdering them. Computer takeovers and control of humans is the theme of numerous science fiction stories. People view themselves as powerless and inadequate before the machine that can perform complex calculations or tasks in fractions of a second. Have you ever felt frustrated playing tic-tack-toe with the computer? Imagine the frustration of backgammon or chess grand masters who can no longer outwit the computer opponent! Will the grand master of chess, someday, be a computer?

Other people see a computer as a maze of confusing buttons and blinking lights. For them the computer is a mystery that they do not want to solve. As a result, they feel helpless before the machine. It seems to have taken control, giving instructions and perhaps even replacing people in their work. In some cases the computer has made certain tasks obsolete. Many companies no longer need people to file bills; newspapers use computers to set type; computers answer complaints and compose "personal" letters; computers diagnose diseases; computers analyze job applications and score tests. Also, the computer seems to have taken the personal touch out of many activities. How do you argue with the computer about a mistake on your gasoline bill? How will the computer recognize and admit its mistakes? And will you get any satisfaction when it apologizes?



The computer: Friend or foe?

When information is stored or analyzed by a computer, it has to be presented in a certain way. You have, no doubt, used test answer sheets that are scored by computers. You transform your name into a series of coded marks and then must mark the answers with a number 2 pencil. Any stray marks will confuse the computer. Moreover, there is no place to explain your answer if you happen to disagree with the multiple choices. The computer seems to say "You do it my way or else. . ." Situations of this type have angered people to protest and display strange fits of anger such as shooting at the computer. (The bullet dented the etal cabinet, but the computer continued to run.)

However, a major issue of growing concern is the question of privacy. When you apply for insurance or a loan, the company wants to know if you are a good risk or if you repay promptly. Information services exist which keep records of one's health reports and credit ratings. For a few dollars the service will send the insurance company a record of your past health reports. Although you may have given permission for your doctor to release your medical records, the company may have also interviewed people who know you to obtain a more complete picture. This is all well and fine if the information is accurate. But what if the person who was interviewed was a neighbor with whom you just had an argument? A list of malicious lies could suddenly appear on your record (for example: You have fits of uncontrolled anger. You beat your wife/husband. You are a druggie. You never wash.) As a result of the information, the insurance company refuses to insure you.

Computer records of our private lives have created a number of difficult problems. Insurance companies or banks need to know if a person is a good risk. Suddenly, the individual's private affairs becomes public record. One does not know who will be using the information or how the information will be used. If the computer files are not carefully guarded, other people could sneak into the files, obtain information and perhaps sell it to someone who uses it to keep a person from getting a job or to buy a house.

What type of information is considered fair to enter into the files? The company might interview your boss or teacher and ask about your behavior at parties. Is that legitimate information or just gossip? A heavy drinker is considered a poor health risk by insurance companies, but are they justified in obtaining information in this way? Moreover, the computer has a large memory and can keep that information and much more for the rest of your life. The record company is in the business of selling information and serves many customers. Department stores, banks, credit card companies, automobile dealers, etc. all make decisions based

on how quickly you pay your bills, how much you make, how much you have borrowed, how much you paid for your house . . . All details of your private life can be obtained from the computer's store of information. Who can see the information? Who controls how the information is collected. What information is necessary to keep on file? How easily is incorrect information changed? Questions of this type become important as computers are used more and more to keep track of what we buy, our traffic tickets, our test scores, our health records, our employment, etc.

Computers have also ushered in a new wave of crimes. The computer criminal, is not the typical, gun waving bank robber. Instead, he or she has expert knowledge of the computer. By changing the program, he or she can transfer money from another bank account to his/her account or write additional pay checks. In one case, a person simply transfered one penny from every bank transaction to his own account and soon became a millionnaire. In electronic banking, one's account is identified by a number code. If someone else discovers your code, he or she can easily use that code to draw out money. Because the computer appears so impersonal and uncaring there is often great temptation to try one's hand at outwitting the system. Also, computer crimes are difficult to detect. Sometimes months or years may pass before a loss of money is detected.

On the other hand, computers can help solve other types of crimes more quickly. Computers keep records of criminals and their behavior and crime patterns. Given the pattern of the crime and perhaps a fingerprint, the computer can almost instantly identify the culprit and pinpoint his/her whereabouts.

Moreover, the computer's great capacity to store, sort out and analyze large quantities of information has permitted people to make decisions faster. Perhaps they make wiser decisions because they have different types of information available and can consider a problem from different viewpoints. For example, computers can help doctors provide better patient care. In the future a new patient might come to a doctor with an unknown disorder. The doctor uses the computer to interview the patient and run a series of tests. From a medical data bank he can then call for the patient's past history. That information and the new information are compared by the computer which then may suggest some possible ailments or predict the probability of a certain disease. The proper drug and its exact dosage are calculated and prescribed. Later, information about how the patient progresses and reacts to the drug can be monitored by computer sensing devices at home and sent to the doctor. The patient needs to make fewer office visits, and yet the doctor can keep close track of the patient.

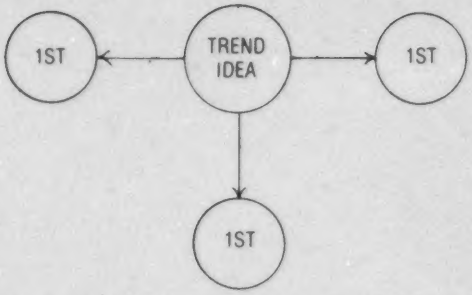
As we can see, the computer is a powerful tool that is changing the way we do things and what we can do. The benefits are great. However, we must be wary of possible adverse effects. How we want to use the computer is still a human decision.

Activity 10: Exploring Computer Effects: The Futures Wheel

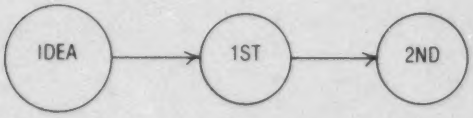
In this exercise you will use a picture-like technique to explore the effects of some predictions or trends you make about the computer. You will do this by constructing a "Futures Wheel." The futures wheel allows you to see the many possible effects that can occur when a new invention is used or when a change takes place. You will show how one effect leads to another effect and how different effects are related. When you have completed the futures wheel and studied the many effects, you can then decide whether or not a new trend or new invention or change is desirable.

Instructions

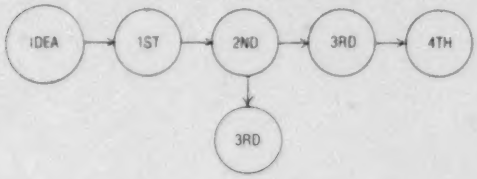
- You will work in pairs or small groups of three or four members.
- Each group will construct a futures wheel similar to the one shown in Figure 1. An example of a completed futures wheel is shown in Figure 2. (*Do not* copy the wheel shown in Figure 1 because your futures wheel may branch out quite differently.)
- First select a new development or trend to study. A number of possible ideas are listed below. These ideas include the trends you examined in the Delphi survey. However, you may wish to identify another idea and use that for your futures wheel.
- On a large sheet of paper draw a circle in the center. Enter the trend/idea you selected in the circle. What are the main effects of this idea/trend? How many did you think of? Draw in as many circles as main effects you identified and connect each to the center circle with an arrow. These are the first order effect.



— Examine each first order effect and decide what types of effects it produces. Some effects may produce one effect, others more. Enter the second order effects and connect them to the first order effects.



— Follow the same procedure for third and fourth order effects. You may find that some effects can produce similar lower order effects. Show this by connecting the appropriate circles.



— Figure 2 illustrates a futures wheel which examines the effects of using computer robots in factories. Study this example. What do you think are the advantages of using robots? Disadvantages?

Some Suggested Ideas and Trends

— Computers with artificial intelligence (i.e., computers that learn from experience and correct mistakes)
— Computers that respond to voice commands
— Personal robots
— Home computers cost less than a TV set
— Books are read off a computer display screen
— Government will have computer files on every U.S. citizen
— Offices in the home
— Mail is sent by computer
— Bills are paid through computers
— Movies are stored in computer banks
— Children are taught by computers
— Computers make decisions for law makers
— Citizens voice opinions and vote by computer

Figure 1. Futures Wheel
52

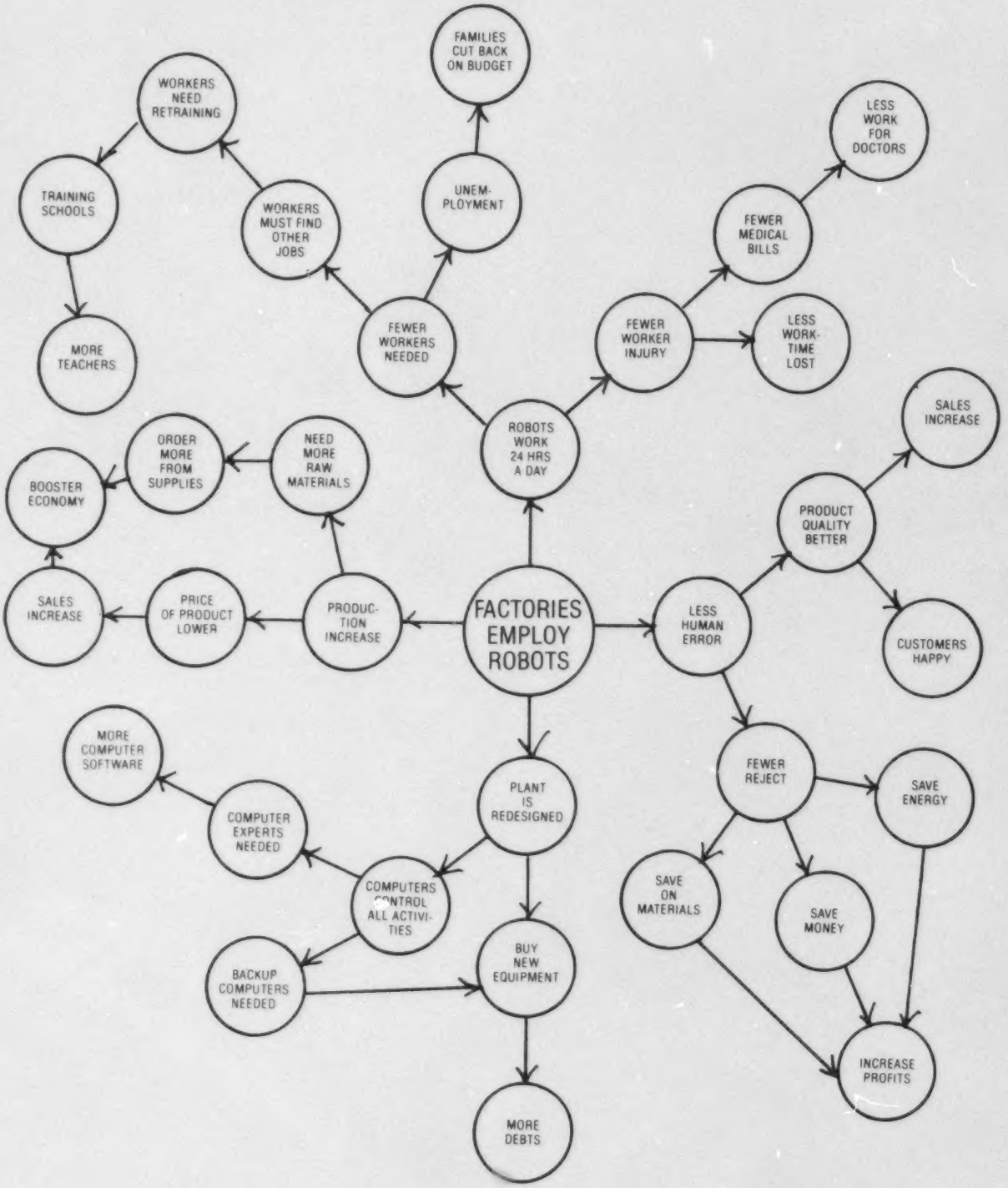


Figure 2: Example of a Futures Wheel & Factories Employ Robots

Reading 7: Computers by the Numbers

It is useful in trying to understand the evolution and impact of computers and computing to note where computers are and who has been using them.

In the early 1950s, almost all computers were owned by or devoted to applications fo the federal government. For example, the first two electronic, digital, stored program computers were ordered by the government to handle the 1950 census.

The computers of 1950 were not devices. They were rooms — big rooms — full of tubes, circuits, ventilating equipment and people. The people carrying tapes, pushing buttons, and lowering the room temperature in these monstrous computers were just as important a computer component as were the tubes and the circuits.

In the mid-1950s, there were fewer than 1,000 computers in the United States. There were fewer than 100,000 computer professionals and about 100 technical leaders in the field in the late 1950s. In the mid-1960s, there were about 30,000 computers — still big, conventional computers.

At the end of 1976, instead of 1,000 contentional computers in the United States, we had some 220,000 computers, about 40 percent being medium or large computers and 60 percent being minicomputers. Minicomputers (minis) are small in size and by definition cost less than $50,000. Most cost less than $20,000. A lot of them cost less than $10,000. As the number of computers increased from 1,000 to 220,000 in 20 years, and the number of computer professionals — analysts, designers, programmers, and operators — increased from about 100,000 to about 2,500,000, the number of users became impossible to count — especially as most computers became part of computer networks. An easy calculation tells us that, with 220,000 computers in the United States and about 220 million people in the United States, there is now one computer for every 1,000 people or one computer for every 240 families. (There were 54 million families in 1975.) That is about one computer for every good-size high rise apartment building or every 240 houses.

And we have not yet mentioned microprocessors or microcomputers. As the number of minicomputers and conventional computers increased from 30,000 to 220,000 in the ten years from the mid-1960s to the mid-1970s, the number of microprocessors increased from none to 750,000.

By 1980 the number of microcomputers will reach about that number (750,000) but the number of microprocessors will be more than 10 million. They are and will be so small — in the range of inches on a side — and so inexpensive — $10 to $500 — for central processing units and logical units that it will be more practical to buy a number of them than to test a single one for reliability.

By the early 1980s, it should be possible to visualize the existence of a complete computer-on-a-chip less than an inch on a side. This minicomputer would consist of a central processing unit, a memory and some simple input/output components. Manufacturing costs should be $10 or less.

As minicomputers became a marketable product, customers and users changed from large institutions to small institutions and wealthy individuals. With microprocessors, the customers are potentially everyone.

In addition, it is estimated that some 30 percent of the computers in the United States are parts of computer networks and that some 34 percent of federal computers are part of networks.

These data are useful in that they make it apparent that we can no longer know who is using computers and what they are computing. Indeed, with anyone with a telephone who can afford $25 to $50 per month or $2 to $5 per hour to rent a computer terminal, the number of users is almost impossible to know.

* * *

The above has been adapted from R.M. Davis, "Evolution of Computers and Computing," Science, Vol. 195, No. 4283, pp. 1096-1102. Copyright 1977 by the American Association for the Advancement of Science.

Activity 11: Forecasting Computer Trends: An Exercise in Trend Analysis

When you attempt to forecast developments in communications or any other kind of endeavor, you never do it in a vacuum. You use knowledge of past events to serve as a basis for projecting into the future. This historical background consists of a list of specific events and a time frame for these developments. For example, from your readings you know that the first computer was built in 1944, that computers were first used by the government in the early 1950's, and that 220,000 computers were in use by 1976. From these and other baseline data we can develop an understanding of the *trend* of computer growth. As a first guess, we can draw a curve of these data and extend them into the future. If we assume that no unforeseen technological inventions will occur and that the rate of growth remains about the same, our forecast should be rather accurate over the short term. This technique is known as extrapolation. Futurists usually restrict their forecasing to a ten year period.

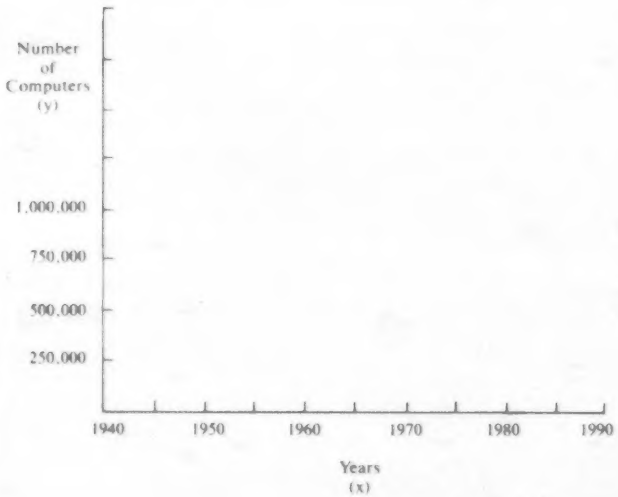
Instructions

Number of Computers — Graph 1

To begin this activity examine the following data.

Year	Number of Computers
1944	1
1955	1,000
1960	30,000
1974	162,000
1976	220,000
1979	903,800

Plot these data on a sheet of graph paper. Label the X-axis "Years" and the Y-Axis "Number of Computers" as shown below.



- After you have plotted the data, draw a freehand line which comes close to all of your points. Extend your line out to 1990. How many computers do you forecast for that year?
- If there were 300 million people in the United States in 1985, how many computers per person would there be in that year?
- If there were an average family size of four people in 1985, there would be one computer for how many families?
- Do you think that most American families might want and be able to afford their own home computer?
- In the previous reading, written in 1977, the author reported a prediction of 750,000 in 1980. Yet in 1979, 903,800 computers were in operation. Why do you suppose the prediction was so low?

Size of Computers — Graph 2

From previous activities and readings you have learned that the size of computers has been drastically reduced. The circuits which once occupied space the size of a moving van are now shrunk down and fit into a chip you can hold on your fingertip. This has been the result of rapid advances in technology based on the development of the transistor in 1947. Wires, vacuum tubes and relays, the first type of circuitry, were replaced by electronic circuits. Circuits, once wired by hand, are now printed on a chip using a photographic process. The wavelength of light limits how much smaller we can make the circuits. To reduce the size a new technology is needed. Scientists are now experimenting with electron beams for printing the circuits so that more circuits can be contained on a chip. The more circuits on a chip, the more information the microcomputer can handle.

How much more circuitry can be packed into the chip? What do you predict?

- Use the following information to construct a graph. Determine the curve and extend the trend line to 1990. Follow the same format you used before.

Year	Number of Circuits on a Chip
1960	1
1975	120
1970	3,200
1975	64,000
1980	100,000

Cost for Computing — Graph 3

With the costs of everything increasing each year it is hard to believe that anything can go down in cost. Yet the cost of computers has steadily declined. When the first pocket calculators came out in 1970, they cost $800. They could add, subtract, multiply and divide.

Today, for $10, you can get a calculator that does the same and more. It would be foolish to think that the price of the hand calculator will go down much further. There are fixed costs such as cost of materials, cost of transportation, cost of assembly, and cost of distribution. We cannot expect the trend line to hit 1¢ if we extend the curve using the above information.

Another way of looking at the cost of computers is to examine how much it costs to do a certain amount of work. Computers today can handle much more information and process information much faster. These factors contribute to decrease cost in using the computer. Also, computers today, because they can handle more information, can perform many more functions. To compare the cost of a 1970 model computer with a 1980 model is like comparing a horse drawn buggy with cars. A better way of comparing computer cost is to compare the cost of performing a certain task. This is like comparing the cost of going from Boston to New York in a buggy and in a car.

- The data below is based on cost of performing multiplications on IBM machines. Use the data to construct a graph. Determine the curve and extend the trend line to 1990. Again, use the procedure previously described.

Year	Cost for Computing 100,000 Multiplications
1956	$1.26
1958	.26
1964	.12
1970	.05
1974	.01

Speed of Computing — Graph 4

How fast a computer works depends on the speed at which it switches work, the opening and closing of gates. The digital computer, which is the one widely used, operates on a counting, two-digit number system: 0 and 1 or "off" and "on." The other type of computer is the analog computer. It operates on a measuring system rather than a counting system. Information or instructions are put into the computer as a long series of 0 and 1 combinations. That is, the computer uses a binary or base 2 system of counting. (Our common counting system is a base 10 system with 10 symbols — 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.) A 1 or 0 is read by the computer in the form of an electrical signal — pulse or no pulse — which switches the closing and opening of gates. Adding numbers, therefore, consists simply of switching a series of electrical circuits. Nonetheless, even a simple addition requires a complex series of circuits. What makes the computer so useful is that switching takes place within a billionth of a second. So, even if a long multiplication problem requires switching thousands of circuits, the computer can do it many, many times faster than you or I.

As mentioned before, the first computers were operated by electrical relays switches. These mechanical iron relay contacts took milliseconds (thousandths of a second) to open and close. In the 1940's the vacuum tube was developed. Turning the vacuum tube off and on took about a millionth of a second. However, both types of switching were slow (from today's point of view) and required large amounts of electricity.

Today's electronic circuits are based on the transistor and the integration of thousands of transistors on a single silicon chip. The use of semi-conductor material and making the parts microscopic allow electrons to flow across shorter distances and more quickly.

- Use the data below to construct a graph illustrating the changes in computing speed. Again, follow the procedure described previously.
- Extend a trend line to 1990. How much faster do you predict computers will operate in 1990?

Year	Instructions Per Second
1953	700
1960	5,000
1965	30,000
1972	150,000
2980	300,000,000

DISCUSSION QUESTIONS

- How do your forecasts compare with those of your classmates?
- What factors might limit any further increase in the number of computers?
- What factors might limit any further increase in number of circuits on a chip?
- What factors might limit any further decrease in the costs for computing?
- What factors might limit any further increase in the speed of computing?
- Do you think that your forecasts were realistic or possible?
- What types of new developments do you think will increase the efficiency of computers?
- How might you be affected by new computer developments?
- How might people who do not understand how to use computers be affected?
- Do you think that people will easily accept the use of computers?

Activity 12: What Are Your Future Visions? A Communications Scenario

In the preceding section you have identified some of your preferences about the computer and its uses as well as looked at some of the current trends. This is also an important research area for the experts in the field of futuristics. However, they, too, do not know for certain what the future holds for the computer. But, in examining trends and social needs, they have constructed some ideas on the direction in which future developments might or should take place.

— In this final activity you will write a scenario describing a future application of the computer.
  - What future changes do you think will take place?
  - How do you think the changes will affect our present way of life?
  - What do you think will be realistic and practical based on what you have learned?
  - Consider the following statement: "The computer has changed our society from an Industrial Society to an Information Society."

— As before, you may present your scenario in one of several ways.
  - A science fiction story.
  - A drawing or chart illustrating a communications network.
  - A description of a day in the life of a person in the year 2000.
  - A description of a school, work situation, a library, etc. which centers around a computer system.
  - A description of the adjustments you must make to live in the computer age (If you want to read a book in bed, will you now bring in the computer display terminal?)
  - A drawing of a computerized home or a home robot. (Include details about how the robot might "see," "feel," receive instruction, etc.)

— Consider the types of computers that are currently available and think about what they can do or be changed to performed more tasks.
  - Computers of the microprocessor type to control and operate other machines (e.g., microprocessors are found in microwave ovens, cameras, cars).
  - Computers of the "stand alone" type which can be used for computing tasks, storing information, recreational games, etc.
  - Computers connected to outside networks so that you can send information as well as receive information and services. In such a system you can receive information from libraries, newspapers, data banks, department stores, banks, film libraries, etc.

— Consider also some of the concerns about the computer that people have voiced.
  - Computers that can understand human speech can eavesdrop on our conversations and keep a record of what we say.
  - Computers with artificial intelligence may decide to do things their own way and ignore our instructions.
  - The government, by keeping detailed records of everyone, can then control how we live our lives.
  - If computer networks are linked to a single large data bank of information, those who run the data bank can control what we will read, see and hear.
  - People will no longer need to think or make decisions if computers can make decisions better and faster.
  - If a large computer system breaks down, such as those that control banking or a subway system, the effects could be disasterous.
  - What might happen if terrorist groups decide to destroy or change the information stored in a computer?
  - If your computer is linked to outside networks, how do you prevent other people from stealing personal information you have stored in its memory system?

— Consider some of the benefits and new opportunities that computers might offer.
  - We can communicate with people anywhere in the world; the computer will display their picture on a screen as well as translate what they say into our language.
  - We can do all our shopping at home. (We wouldn't have to wait for our local store to stock a new product — we can simply ask for information on new products, and pictures and descriptions will appear before us on the screen.)
  - We can get information from any type of library through our home computer.
  - Driving will be easier and safer because cars will be computer driven.
  - We will have a greater choice of entertainment.

— Professor Michael L. Dertouzos, a computer scientist at MIT, has suggested the following scenario for an automated factory. This type of production, he believes, will offer people more choices and personalize the marketplace. Also, there is less waste and costs will be lower. (We have shortened his scenario to a brief outline.)

A Shoe Making Scenario

Step One:

Go to a computer shoe center — the "Auto Shoe".

Step Two:

Put feet in feet measuring machine. Machine measures feet and gives you a card with your name and the coded measurements of both feet.

Step Three:

Select the shoe style you want at the shoe-design station. Also indicate the color type of material and any other added touches.

Step Four:

Before you order you want to know how the shoe will look. You inform the computer, and an image of yourself wearing the shoe appears on a large display screen. You like what you see.

Step Five:

Order shoe by inserting your foot size card and pay for shoe with your money card.

Step Six:

The information is sent to the production room. There machines pick out the materials, cut the pattern and assemble the shoe.

Step Seven:

Shoe made to your exact size and instructions comes out of delivery chute. It has been exactly 11 minutes since you entered the store.

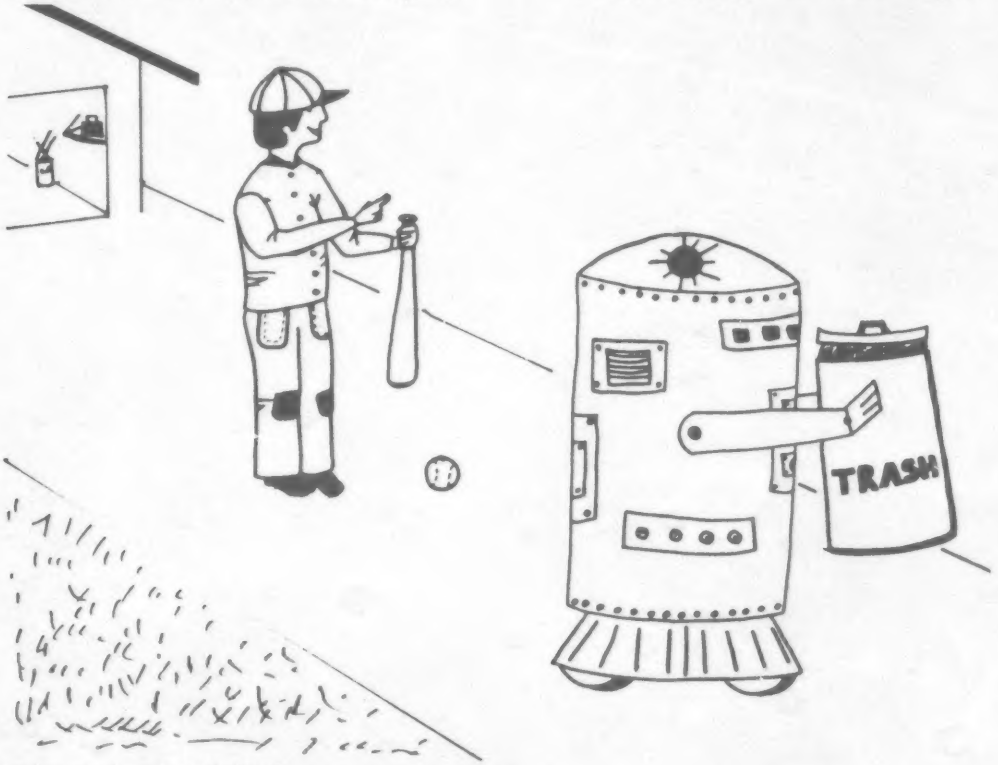
Before a fully automated production system, such as described on previous page, becomes a reality, certain technological developments need to take place. The developments Dr. Dertouzas consider include the following:

- Develop a device for making the foot measurements. A computerized device then uses these measurements to create two dimensional patterns for making the shoe pieces.
- Develop machines with mechanical arms to go along a stock room collecting the parts for the shoe.
- Develop computers to cut materials according to size and pattern.
- Develop a method for combining the picture of the person obtained by a television camera with a computer picture of the shoe and show it on a display screen.
- The "ordering of the shoe" information will need to be tied into the computer network of the company's accounting system and the customer's banking system.
- Create an automated robot that will assemble the parts into a shoe. This mechanism, he felt, was the most difficult technically. The robot must be able to sense what needs to be done and adjust its actions according to the shape and design of the shoe to be constructed and the materials to be used.

While an automated shoe store will save money and provide customers with greater choice and exact fit, Dr. Dertouzas suggests that some problems might be created.

- Having robots do our work may reduce our skills. (For example, school children today are less able to add and subtract because they depend on calculators.)
- We may begin automating things that need not be automated because we think that machines can do everything (even when machines do not perform the job as well).
- People begin to feel helpless when machines take over so many tasks.
- Many workers will be left without jobs.
- The task of keeping the machines working may be enormous. All the components must work together smoothly. A breakdown can completely interrupt the entire production sequence. (If a worker gets sick, another can easily take his/her place.)
- If the automated factory requires change, the entire complex program of instructions need to be changed. (When a factory uses people, people can easily adjust to new assignments or learn another task. A change may involve shifting only a few jobs around.)

— Your future communications scenario will deal with change. As you develop your scenario, think about those changes carefully. What are the benefits? What are the disadvantages?



Robots doing our work — good or bad?

Glossary

Computer "Lingo"

artificial intelligence — the processing of information by machine to resemble human thinking.

bit — a digit of the binary system (zero or one).

byte — a unit made up of eight bits of information and functioning as a single unit.

central processor — component of the computer which controls and coordinates all activities. It usually consists of a unit to perform the arithmetic, a unit to control the sequence of activities and a memory unit.

data — the information stored in or received from a computer.

databank — a set of data stored in a computer memory system that can be accessed (used) by a number of terminals located at different places (e.g., airlines use their databank to make reservations, keep track of flights, arrange seating, sell tickets, etc.).

display screen — a TV-like screen on which the computer presents its information (words, numbers, pictures, graphs, etc.).

file — a set of related data.

hardware — the actual pieces of physical equipment that make up a computer system. The basic components include the central processing unit, a keyboard for entering the data, a TV-like screen for displaying the results and a device for storing the information.

input — transfer of data or instructions to the computer.

keyboard — device resembling a typewriter used to send instructions to the computer.

magnetic dish — a device for storing large amounts of information. The information is stored as patterns of magnetizations on the surface of the disk.

magnetic tape — a device for storing large amounts of information. It is similar to tapes used in tape records.

memory — the information contained in the storage device of a computer.

millisecond — a millionth of a second.

nanosecond — a billionth of a second.

output — transfer of information from a computer processor or memory to the outside.

printout (or hard copy) — a printed copy of information produced by the computer. This requires a printing device connected to the system.

program — the instructions that control the computer.

software — programs that are used to direct the computer.

storage capacity — the maximum amount of information which a computer system can store at one time.

terminal — an input-output device connected to a computer system by a communication's linkage.

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